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PB-288 980

A Manual for the Identification of the Larvae of the Caddisfly Genera 'Hydropsyche' Pictet and 'Symphitopsyche' Ulmer in Eastern and Central North America (Trichoptera: Hydropsychidae)

Kansas State Biological Survey, Lawrence

Prepared for

Environmental Monitoring and Support Lab.-Cincinnati, OH

Oct 78

United States
Environmental Protection
Agency

Environmental Monitoring and Support
Laboratory
Cincinnati OH 45268

EPA-600/4-78-060
October 1978

Research and Development

PB 288980

EPA

A Manual for the Identification of the Larvae of the Caddisfly Genera *Hydropsyche* Pictet and *Symphitopsyche* Ulmer in Eastern and Central North America (Trichoptera:Hydropsychidae)

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TECHNICAL REPORT DATA

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1. REPORT NO. EPA-600/4-78-060	2.	3. RECIPIENT'S ACCESSION NO. PB288980
4. TITLE AND SUBTITLE A MANUAL FOR THE IDENTIFICATION OF THE LARVAE OF THE CADDISFLY GENERA HYDROPSYCHE PICTET AND SYMPHITOPSYCHE ULMER IN EASTERN AND CENTRAL NORTH AMERICA (TRICHOPTERA: HYDROPSYCHIDAE)		5. REPORT DATE October 1978 issuing date 6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) Guenter A. Schuster and David A. Etnier		8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS State Biological Survey of Kansas, The University of Kansas, Lawrence, KS, 66044 and Department of Zoology, The University of Tennessee, Knoxville, TN 37916		10. PROGRAM ELEMENT NO. PE 1BD612 11. CONTRACT/GRANT NO.
12. SPONSORING AGENCY NAME AND ADDRESS Environmental Monitoring and Support Lab. - CINN, OH Office of Research and Development U.S. Environmental Protection Agency Cincinnati, OH 45268		13. TYPE OF REPORT AND PERIOD COVERED Final 14. SPONSORING AGENCY CODE EPA/600/06
15. SUPPLEMENTARY NOTES		

16. ABSTRACT

Larvae of the caddisfly genera Hydropsyche and Symphitopsyche are among the most encountered and abundant organisms of lotic environments in eastern North America. Yet, little is known of the larval stages of these genera. Previously, the larvae of only 12 species of which descriptions are presented here, were known. Descriptions of larvae of an additional 27 species are here presented for the first time. Presented here are the descriptions of the larvae of 14 of 15 nominal eastern species of the genus Symphitopsyche, and 25 of 34 of the genus Hydropsyche; 18 of 24 of the scalaris group, 6 of 9 of the depravata group, and the single species of the cuanis group, H. cuanis Ross. A key is provided for known larvae, incorporating a number of characters previously unused in the taxonomy of these two genera. The key is based on ultimate or penultimate larval instars since color patterns may be more variable in earlier instars. Larvae of S. piatrix have not definitely been associated with metamorphotypes; however, larvae were collected near the type locality, and the presumed larvae of this species is described, illustrated, and keyed. A listing of all unassociated species, with known distribution and literature citations, is given. In addition to the description of the larvae, the following are presented for each of the associated species of Hydropsyche and Symphitopsyche: known range, notes on the biology, diagnosis, intraspecific variation, material examined, complete literature survey and synonomies, and illustration of the head capsule and pronotum.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Aquatic Biology Freshwater biology Indicator species Benthos Insects Larvae Life cycles Ecology Taxonomy	Trichoptera Hydropsychidae Hydropsyche Symphitopsyche Caddisflies	6C 6F

18. DISTRIBUTION STATEMENT RELEASE TO PUBLIC	19. SECURITY CLASS *(This Report)* UNCLASSIFIED	21. NO. OF PAGES 144
	20. SECURITY CLASS *(This page)* UNCLASSIFIED	22. PRICE PC A07 / MF A01

EPA Form 2220-1 (9-73)

★ U.S. GOVERNMENT PRINTING OFFICE: 1978— 557-060/1502

EPA-600/4-78-060
October 1978

A MANUAL FOR THE IDENTIFICATION OF THE LARVAE OF THE CADDISFLY GENERA *HYDROPSYCHE* PICTET AND *SYMPHITOPSYCHE* ULMER IN EASTERN AND CENTRAL NORTH AMERICA (TRICHOPTERA:HYDROPSYCHIDAE)

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FOREWORD

Environmental measurements are required to determine the quality of ambient water, the character of effluents, and the effects of pollutants on aquatic life. The Environmental Monitoring and Support Laboratory - Cincinnati conducts research to develop, evaluate, and promulgate methods to:

* Measure the presence and concentration of physical, chemical, and radiological pollutants in water, wastewater, bottom sediments, and solid waste.
* Concentrate, recover, and identify enteric viruses, bacteria, and other microorganisms in water.
* Measure the effects of pollution on freshwater, estuarine, and marine organisms, including the phytoplankton, zooplankton, periphyton, macrophyton, macroinvertebrates, and fish.
* Automate the measurement of physical, chemical, and biological quality of water.
* Conduct an Agency-wide quality assurance program to assure standardization and quality control of systems for monitoring water and wastewater.

The effectiveness of measures taken to protect the biological integrity of the Nation's surface waters is dependent upon our knowledge of the environmental requirements of aquatic organisms and our understanding of the the complex relationships that prevail in aquatic ecosystems. Caddisflies are important components of aquatic food webs and are useful water quality indicator organisms. This manual contains an illustrated key and descriptions for 39 species of caddisfly larvae, previously difficult to identify to the species level. Also included are notes on the ecology and distribution of each species, intraspecific variation, synonomies, and a complete literature survey. The manual was developed to assist biologists in evaluating data collected during studies of the effects of toxic substances and other pollutants on the structure of indigenous communities of aquatic organisms.

Dwight G. Ballinger
Director
Environmental Monitoring and
Support Laboratory - Cincinnati

ABSTRACT

Larvae of the caddisfly genera *Hydropsyche* and *Symphitopsyche* are among the most encountered and abundant organisms of lotic environments in eastern North America. Yet, little is known of the larval stages of these genera. Previously, the larvae of only 12 species, of which descriptions are presented here, were known. Descriptions of larvae of an additional 27 species are here presented for the first time.

Larval-adult associations were made by simultaneously collecting metamorphotypes (pharate adults) and larvae. Species determination is based on the cleared male genitalia of the pharate adults. The abdomens were cleared in strong KOH so that sclerotized structures lying beneath surrounding tissues could be examined. Larvae were studied using both compound and dissecting microscopes; scale hairs, club hairs, and minute spines of the abdomen are best studied under high magnification. The larval abdomens were cleared in strong KOH and put into glycerin on a microscope slide for examination.

Presented here are the descriptions of the larvae of 14 of 15 nominal eastern species of the genus *Symphitopsyche*, and 25 of 34 of the genus *Hydropsyche;* 18 of 24 of the *scalaris* group, 6 of 9 of the *depravata* group, and the single species of the *cuanis* group, *H. cuanis* Ross. A key is provided for known larvae, incorporating a number of characters previously unused in the taxonomy of these two genera. The key is based on ultimate or penultimate larval instars since color patterns may be more variable in earlier instars.

Larvae of *S. piatrix* have not definitely been associated with metamorphotypes; however, larvae were collected near the type locality, and the presumed larvae of this species is described, illustrated, and keyed. A listing of all unassociated species, with known distribution and literature citations, is given.

Characters utilized in the key to facilitate separation of species include: color pattern of head; morphology of anterior margin of frontoclypeus; presence of large tubercle on center of anterior ventral apotome; presence or absence of club hairs, scale hairs and/or minute spines on dorsum of abdomen; and presence of large, heavily sclerotized spine-like setae on venter of anal legs. Minute abdominal spines are described and utilized as a taxonomic character for the first time.

In addition to the description of the larvae, the following are presented for each of the associated species of *Hydropsyche* and *Symphitopsyche:* known range, notes on the biology, diagnosis, intraspecific variation, material examined, complete literature survey and synonomies, and illustration of the head capsule and pronotum.

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ACKNOWLEDGMENTS

This publication is adapted, in part, from a dissertation presented to the faculty of the Graduate School of the University of Tennessee by the senior author, in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

We are very appreciative of the role the State Biological Survey of Kansas has played in the publication of this manuscript. We are grateful to its director, Dr. Ronald L. McGregor, and to Donald G. Huggins, in charge of the Aquatic Invertebrate Survey Section, for their encouragement and support, and especially for providing the clerical assistance necessary to prepare the photo-ready copy of this manuscript.

The senior author would like to express his appreciation to Drs. Dewey Bunting, Melbourne Whiteside, and Susan Riechert, Department of Zoology, and Dr. Paul Parmalee, Department of Anthropology, for their criticisms of the manuscript and for serving on his doctoral committee.

A special expression of gratitude is extended to Drs. Oliver S. Flint, Jr., Department of Entomology, Smithsonian Institute, and John D. Unzicker, Faunistics Survey Section, Illinois Natural History Survey, for freely giving much valuable time and advice during the course of this study. We are also grateful to them for allowing the senior author to visit their respective institutions, study specimens in their holdings, and borrow extensive amounts of *Hydropsyche* and *Symphitopsyche* material.

We wish to express gratitude to the many people who contributed specimens or assisted in collections for this study, especially the following: Fae Andrews, Noel Burkhead, William Dickinson, Mark Hughes, Lynn and Wayne Starnes, Anthony Talak, Virginia Tolbert, G. William Wolfe.

Special consideration is given to the following who gratiously supplied larvae and/or metamorphotypes of *Hydropsyche* and *Symphitopsyche* species for study: Dr. Bruce Wallace, University of Georgia (*S. macleodi*); Dr. Kenneth Stewart, North Texas State University (*H. simulans*); and Dr. Todd Harris, Purdue University (*S. sparna, H. betteni,* and *S. morosa*); Drs. G. L. Harp, Arkansas State University and H. W. Robinson, Southern Arkansas University (presumed larva of *S. piatrix*).

Gratitude is also expressed to Sigma Xi for awarding a grant which made possible several fruitful collecting trips and to Highlands Biological Station, Highlands, North Carolina, for supporting two weeks of study at the Biological Station; and to the Southern Region Educational Board for the funding which made the visits to the Smithsonian Institute and Illinois Natural History Survey possible.

Special gratitude is given to Dr. H. H. Ross for allowing us to redraw illustrations which appeared in his 1944 work, "The Caddis Flies, or Trichoptera, of Illinois." We would also like to express our appreciation to Drs. Oliver S. Flint, Jr., Andrew P. Nimmo and Glenn B. Wiggins for reviewing this manuscript and offering valuable suggestions which considerably improved the final product.

We are grateful to Ms. Claire Schuster for typing the first draft of the manuscript, and to Ms. Jan Powers for typing the final camera-ready copy. Both attacked this chore with great enthusiasm even after numerous retyping of pages.

Last, and most of all, we wish to thank our wives and families for their assistance in the field, and their support throughout this study.

SECTION 1

INTRODUCTION

Studies of North American Trichoptera have been most concerned with adult systematics (Betten, 1934; Ross, 1944). In general, it is true that the systematics of adult caddisflies is much better understood than that of their corresponding larval forms. Of the nearly 1,000 described Trichoptera in North America, the immature stages of only 20 percent of these species are known (Wiggins, 1964).

Resh (1973:1) points out that "the need for keys to identify the immature stages of caddisflies has become increasingly important with regard to understanding their potential as water quality indicators. Very common genera, such as *Cheumatopsyche* and *Hydropsyche* (*sensu* Ross, 1944) of the family Hydropsychidae are almost totally unknown in the aquatic stages." Studies on caddisfly larval taxonomy are not only important for the realization of their potential as water quality indicator organisms but also are vital for a number of other reasons.

First, such studies may be used as a starting point from which natural history and a wide spectrum of ecological researches may be based. Any such studies hinge on correct species determination. Second, and most important from the "trichopterologist's" point of view, such studies give a new dimension, the larva, from which data may be gleaned. A knowledge of the immature stages may develop a greater understanding of the systematics and phylogenetic relationships within Trichoptera. Ultimately, these may give rise to a better understanding of the entire order Trichoptera.

Early works on North American Trichoptera (Say, 1823, 1824, 1828; Walker, 1852; Hagen, 1860, 1861, 1864, 1866, 1868, 1873, 1875; McLachlan, 1863; Banks, 1894, 1895, 1897, 1899, 1900a, 1900b, 1900c, 1901a, 1901b, 1903a, 1903b, 1904a, 1904b, 1904c, 1904d, 1905a, 1905b, 1907a, 1907b, 1908a, 1908b, 1909, 1911, 1914, 1916, 1918, 1920, 1924, 1930a, 1930b, 1936a, 1936b, 1938, 1943, 1944; Betten, 1950; L. Milne, 1934-36) were almost completely restricted to adult systematics. It was not until the turn of the century that workers began to study the larvae in greater detail. Workers such as Betten (1902, 1934), Lloyd (1915, 1921), M. Milne (1938, 1939) laid the foundations for early larval work. However, it was not until the classic work by Ross (1944), "The Caddis Flies, or Trichoptera of Illinois", was published that taxonomic keys were available for the greater majority of Trichoptera larvae. This work has been the single most authoritative study on North American caddisflies. It not only dealt with the species of Illinois, but also most amply illustrates all known widespread species. In it Ross compiled keys to the larvae of families and genera and, whenever known, to the species level. The importance of this work cannot be overstressed.

Wiggins (1977) is the major contribution dealing with larval systematics, on the generic level, for the entire order since Ross, 1944. This work is an indicator that in recent years researchers have increasingly directed their attention to larval forms. The systematics of immature forms has been worked out for a number of genera and families. Wiggins (1960) discussed the larvae of the caddisfly family Phryganeidae; Wiggins and Anderson (1968) made special reference to the immature stages of *Pseudostenophylax* and *Philocasca*. Wiggins (1973a, 1973b) discussed the larval systematics of several genera of the family Limnephilidae. Merrill and Wiggins (1971) and Yamomoto and Wiggins (1964) respectively described the larvae of *Setodes* and *Mystacides* of the Leptoceridae. Other authors have worked extensively with larval taxonomy; Flint (1960), the taxonomy and biology of limnephilid larvae; Flint (1961), the immature stages of Arctopsychinae; Flint (1962), *Rhyacophila*; Flint (1964), Psychomyiidae; Wallace and Sherberger (1970), Calamoceratidae; Sherberger and Wallace (1971), *Molanna*; Wallace (1971), *Brachycentrus*; Ross and Wallace (1974), Sericostomatidae; Resh (1973, 1976), *Ceraclea*.

Recent European authors have also done a great deal of larval work; Lepneva (1964, 1966), the larvae and pupae of Annulipalpia and Integripalpia, respectively; Hicken (1967), the caddis larvae of Great Britain; Hildrew and Morgan (1974), the taxonomy of British Hydropsychidae; Sed Lak (1971), *Hydropsyche* of Checkoslovakia.

The genera *Hydropsyche* and *Symphitopsyche* consist of approximately 70 species in North America of which about 50 are restricted to eastern and central North America. The North American species of *Hydropsyche* are divided into three species groups (Ross, 1944); the *cuanis* group, the *depravata* group, and the *scalaris* group. The *cuanis* group consists of a single species, *H. cuanis* Ross. The *depravata* group consists of nine nominal species, all of which are found in eastern and central North America with *H. guttata* Pictet being holarctic in distribution. The remaining 32 species belong to the *scalaris* group of which 24 are more or less restricted to eastern and central North America.

The genus *Symphitopsyche* was until recently (Ross and Unzicker, 1977) considered part of *Hydropsyche* (the *bifida* species group in Ross, 1944). The genera as adults are separable primarily on the basis of the morphology of the aedeagus and the 9th and 10th abdominal segments. As larvae they are separable on the basis of club and scale hairs and absence or presence of minute spines on the dorsum of the abdomen. *Symphitopsyche* in North America is composed of approximately 30 species of which about half are found in eastern and central North America.

The only key to the larvae of these two genera is that of Ross (1944) in which both genera were treated under *Hydropsyche*. Twelve species are keyed and 2 additional species, not keyed, are briefly described. The study of the larval taxonomy of the genera *Hydropsyche* and *Symphitopsyche* has been in limbo since that publication, even though the larvae are commonly encountered, often in very large numbers in almost all types of lotic environments in eastern North America.

The primary purpose of this study is to associate the larvae of the species of *Hydropsyche* and *Symphitospyche* distributed in eastern and central North America and to construct a key for the identification of these larvae. Secondary reasons for this study are: (1) to present distributional data on many of the little known species in these genera, (2) to give emergence dates to assist future workers of *Hydropsyche* and *Symphitopsyche*, and (3) to give notes on the biology of all species that have been associated.

SECTION 2

THE GEOGRAPHIC LIMITS

At the onset of this study, it was determined that the southeastern United States be used as the study area. However, as the study progressed, an increasing number of species were associated so that it became feasible to encompass the entire eastern and central North American region.

SECTION 3

COLLECTING TECHNIQUES

Collections were made in springs, streams, and rivers; all types of lotic environments were sampled. A collecting site was selected on the basis of the amount of riffle habitat in the area. *Hydropsyche* and *Symphitopsyche* larvae prefer these types of habitats over areas consisting of a long, smooth run. Each likely site was systematically examined for larvae and metamorphotypes (M. Milne, 1934; pharate adults, *sensu* Hinton, 1971 and Wiggins, 1977). Initially, at each locality, the fastest water was selected to be sampled first. In each riffle, rocks were picked up and examined for larvae and pupae. Since some *Hydropsyche* and *Symphitopsyche* species seem to have a definite preference for rock size and shape, many types and shapes of rocks were examined. Often larvae and pupae may congregate in spaces between rubble on the bottom. These areas were also examined. When the boulders were too large to move, they were examined underwater. While steadily anchoring oneself in the riffle or rapid, a hand may be taken and gently run across the surfaces and crevices of the rocks. With some experience one obtains a feeling for larval nets and pupal cases, and these may be grasped underwater. Although this is a tedious task, it is a very fruitful method with strata which cannot otherwise be sampled.

Once the riffle habitats were thoroughly examined, other areas of the stream or river were then collected. Runs may often be more difficult to collect than riffle areas because they are usually much deeper, and submerged rocks, logs, or branches are not as accessible. Long-handled aquatic nets and dredges are of use in such areas.

Sand streams and streams below the fall line also presented collecting problems. In such streams, which may be sluggish, it was often difficult to determine where the *Hydropsyche* habitat existed. It was often exasperating to collect *Hydropsyche* adults in such areas and not find any larvae or pupae. It was found profitable, while collecting such streams, to put submerged materials such as debris, logs, and branches in the sun to dry. Larvae which had burrowed into these would invariably crawl out in a few minutes and could then easily be collected. Collecting metamorphotypes here, however, was not so easy. To obtain these, the submerged materials were picked or torn apart piece by piece after the larvae were collected. This was very time consuming. If time was of the essence, these materials were put into the collecting vehicle and picked enroute to the next site or were examined later that evening.

At each locality an effort was made to obtain adults by searching emergent and marginal vegetation. The undersides of bridges were also examined. During the day, adults were captured with the use of an aspirator. In the evening collections were made in a number of ways. Firstly by examining neon signs and other lights near the stream; secondly, portable light traps were set up along the banks of the stream. These lights were either flourescent or blacklights powered by 6 volt batteries. Placed near each light was a pan half filled with 70% isopropyl alcohol, and adults would drop directly into these pans. Third, when flourescent or blacklights were unavailable, a Coleman lantern was used in a similar manner as described above. In addition to collecting adults directly into alcohol pans, it was convenient to place the lights near a draped white sheet or the hood of a car; adults were aspirated as they alighted on these. This method allowed more selectivity in the forms collected.

All adults collected were preserved in 70% to 75% isopropyl alcohol. The larvae and metamorphotypes were initially collected in vials containing 95% to 100% isopropyl alcohol because of the large amounts of water introduced into the vials with larvae and pupal cases. If large quantities of larvae and pupal cases were collected, alcohol was changed immediately after the collection was made and again within 2 or 3 days with 70% isopropyl alcohol after the specimens had sufficiently hardened.

Previous published and unpublished *Hydropsyche* and *Symphitopsyche* adult collection records contributed greatly to the success of this study. These records gave important data with regard to locality and dates or probable emergence periods. These provided an excellent starting point for collecting larvae and metamorphotypes.

SECTION 4

METHODS

Initially, it was intended that many species of *Hydropsyche* and *Symphitopsyche* larvae and adults would be associated by larval rearing. However, because of the need for constant running water at cold temperatures and the existence of probably a number of limiting factors such as dissolved oxygen, photo-period, suspended nutrients, and various chemical requirements not yet defined, our limited attempts at rearing met with failure. Therefore, this method was abandoned so that all the investigative efforts and time could be employed collecting metamorphotypes (mmts.). The "metamorphotype method" was first described by M. Milne (1934), and proved invaluable in this study.

The metamorphotype or pharate adult is a feature of great importance to the study of Trichoptera. It represents a period in the life of the individual caddisfly in which all three stages of the holometabolous life cycle are available for study -- larva, pupa, and developing adult.

The larva encapsulates itself into a silken case (Fig. 7-8) to the outside of which rocks, sand, vegetation, or other debris is glued. The underside is shaped by the substrate. As the larva undergoes metamorphosis and changes into a pupa, the larval sclerites are sloughed and packed into the back of the case where they remain during subsequent development. The pupa then develops into the adult with the formation of wings, partial atrophy of mouth parts, and sclerotization of genitalia. If these are collected after the sclerotization of genitalia and before emergence of the adult, the investigator has available the larval sclerites, pupal skin, and adult genitalia by which species identification is made. Therefore, an absolute larval-adult association has been accomplished.

During this study, it was found that one may reliably tell if the adult genitalia were sufficiently sclerotized by the color of the eyes of the pupa. If the eyes were dark rather than white, one could be assured of sufficient sclerotization. Dark wing coloration may also be a good indicator of this. If only immature pupae are collected, they may be placed into small jars, on moist sphagnum moss, and stored in a refrigerator until further development has taken place (Wallace, personal communication).

Sclerotization of genitalia is important for several reasons. First, soft genitalia may adhere to the pupal skin and make adequate examination impossible. Second, the true shape of the aedeagus and claspers is not evident until sclerotization has taken place. For this reason examination of an immature specimen may lead to faulty identification if extreme care is not taken. Last, it is often necessary to examine morphological features of the genitalia which are imbedded in surrounding tissue. To do this, the abdomen is cleared in solution of KOH. If the genitalia are not adequately sclerotized, some of the features may be lost by the action of the KOH.

Once mature pupae were collected, preserved, and hardened, they were examined and the larval sclerites retrieved from the pupal case. *Hydropsyche* and *Symphitopsyche* pupal cases usually were attached to rocks or other substrates. Because of this, one side of the case is flat and without an outer covering of granules in order to attach snuggly to the substratum. This provides an excellent area to open the case and assure minimal damage to the pupa and little loss of the larval sclerites. Often, however, *Hydropsyche* and *Symphitopsyche* pupal cases may be attached to strands of *Potamogeton* or *Podostemum*. If so, the pupal case was completely cylindrical with granules (Wentworth Scale, after Wentworth, 1922) attached on all sides. It was extremely hard to tell in such situations which was anterior or posterior. One must take great care in opening these cases since the granules were usually rigidly attached to one another and difficult to pry apart. It was best to begin prying near either end of the case. With the removal of a few granules, one can quickly observe either the anterior or posterior end of the pupa. If the posterior end was opened, it was found best to stop and open the other end. This prevented scattering of larval sclerites. Once the anterior end has been opened, very fine forceps may be used to extract the pupa from the case. After the pupa has been removed undamaged, the rest of the case may be opened to retrieve the larval sclerites.

The larval sclerites were picked up individually and placed into a microvial. After all the larval sclerites were placed in the microvial, the pupa was also put into it, thereby isolating each pupa and its sclerites from those of other specimens.

The microvials are of clear plastic tubing with outer diameter of 4.0 mm and inner diameter of 3.5 mm. The tubing was cut into 15 mm sections with one end being heated and pinched off. These made excellent microvials as pupae of most *Hydropsyche* and *Symphitopsyche* species fit snuggly into them, and cotton stoppers were not required. This allowed for storage of 30 to 40 pupae and sclerites in one 3-dram vial.

Since not all individuals in a *Hydropsyche* or *Symphitopsyche* population pupate simultaneously, larvae of the same species were usually collected with metamorphotypes. Larval sclerites from the metamorphotypes collected were matched with larvae collected at the same locality. This resulted in definite larval-adult associations. If no larvae were collected with the metamorphotypes, attempts were made to go back at a later time specifically to collect larvae.

The larva of *S. piatrix* (Ross) has not definitely been associated using metamorphotypes. However, larvae were collected near the type locality, and the lack of other nonrecognizable larvae presents strong evidence that these larvae are in actuality those of the above species. The presumed larva of this species is described, illustrated, and keyed.

Species identification of metamorphotypes was based on genitalia. Present adult *Hydropsyche* and *Symphitopsyche* taxonomy is based solely on the genitalia. The pupal skin was carefully removed from the abdomen to minimize the damage. This exposed the genitalia for close observations. Often the abdomen had to be cleared for examination of internal structures embedded in surrounding tissues.

The clearing process was done as described by Nimmo (1971). A strong solution of potassium hydroxide was made, into which the detached pupal abdomen was submerged. This solution was brought to a gentle boil for a few minutes. The abdomen was then retrieved and placed in a weak solution of acetic acid (10%) and returned to the hot KOH. This produced a massive release of bubbles which dislodged tissue surrounding the genitalia. This process was repeated until all surrounding tissue was cleared. When this was accomplished, the abdomen was washed with the acetic acid one last time to stop the clearing process. The abdomen may then be placed in glycerin or alcohol for further examination. The amount of time required for clearing could not be standardized. The size of the specimen and its state of preservation determined the amount of time needed for the process.

In order that the scale hairs (Fig. 10), club hairs (Fig. 12), and minute spines (Fig. 10) on the abdomen could be more easily studied, the abdomen of the larva was removed and treated in a similar manner. Once the abdomen has been cleared, it may be put into glycerin on a microscope slide and observed under a compound microscope. If the larva was not well preserved, the internal tissues may be gently teased from the abdomen with very fine forceps; the end result is the same as that of clearing in KOH.

SECTION 5

MATERIAL EXAMINED AND BORROWED

Larvae and pupae of the following species were borrowed from the Illinois Natural History Survey (INHS): *H. arinale*, *S. bronta*, and *H. cuanis*. Adult material of *H. catawba*, *H. hageni*, and *H. leonardi* were also borrowed from the INHS. All other material used to construct keys, and make descriptions, and illustrations for this study were collected by the authors, or fellow graduate students at the University of Tennessee, Knoxville.

All available type material of *Hydropsyche* and *Symphitopsyche* species in the collections of the INHS and the U. S. National Museum (USNM) was examined. Identified material for species, whose types were deposited elsewhere, was also examined at the above institutions. A period of 1 week was spent at each museum by the senior author at which time all species identifications made during this study were verified.

SECTION 6

GENERALIZED DESCRIPTION OF *HYDROPSYCHE* AND *SYMPHITOPSYCHE* LARVAE

Larva campodieform (Fig. 1). Head in dorsal view (Fig. 3) subsquadrate to subrectangular. Frontoclypeus subtriangular; approximately three-fourths total length of head; posterolateral margins meet to form an acute angle; anterior margin straight or convex and toothed. Labrum (Fig. 4) convex dorsally; anterior margin rounded; outline subtrapazoidal. Surface of labrum covered with numerous long setae; lateral margins fringed with long setal brush. Mandibles (Fig. 5) triangular with five to seven teeth on apical half of inner margin; left mandible with tuft of yellow setae above most proximal tooth; right mandible without such a brush. Left mandible with large cavity below dorsal ridge; ridge mandible without such cavity. Both mandibles with long, thin setae on lateral margins. Maxillary palp five segmented; lacinia conical; hypopharynx mesad of maxillae. Submentum (Wiggins, 1977) (Fig. 2) with pair of anterior truncate lobes; anterior ventral apotome (Wiggins, 1977) (Fig. 2) subtriangular. Genae fused ventrally with small triangular posterior ventral apotome or protogula (Fig. 2) (Badcock, 1961) at posterior end of gular suture. Ventral surface of genae behind mandible with band of numerous ridges (stridulatory surface) (Fig. 2).

All three thoracic segments sclerotized dorsally. Nota subquadrate; pronotum with median suture line; mesonotum with large black U-shaped mark posteriorly; metanotum with posterior short black slash mark; each notum with black lateral margins. Strap-like prosternum (Fig. 6) behind first pair of legs; additional pair of less sclerotized prosternal plates just posterior to prosternum. Mesosternum with pair of weakly sclerotized triangular sclerites behind mesothoracic legs; metasternum lacking sclerites. Propleuron rectangular with diagonal black line; foretrochantin (Fig. 1) forked with thin, short, black hairs. Prothoracic legs more robust, shorter than posterior two; all segments of forelegs stouter than those of other legs. Femur of front legs flattened; posteromesal margin with group of long, heavy, black setae. Segments of all legs abundantly adorned with long, black setae and short, golden brown spine-like setae.

Abdomen covered with many thin, short, black setae. Scale-like hairs and minute spines (Fig. 9-10) typically located on dorsum of abdominal segments of *Hydropsyche* species. Club-like hairs (Fig. 12) present on dorsum of abdominal segments of *Symphitopsyche* species; club hairs as long as other hairs only slightly thicker; *Symphitopsyche* species lack minute spines on dorsum of abdomen. Abdominal segments III - VII, respectively, possessing 1, 3, 3, 3, and 2 pleural gills (Fig. 1); these gills are conical, often covered with short, black setae. Ventral gills on thoracic segments II - III and on abdominal segments I - VII (Fig. 1). One pair of gills on second thoracic segment; each of a single stalk with numerous single filaments attached to it. Third thoracic segment with four gills; two laterally, two mesally; filaments similar to these of gills on second segment; mesal gills near center of segment. Gills of abdominal segment I similar to those on third thoracic segment; medial gills widely separated and close to lateral gills. Gills of abdominal segments II - VI similarly arranged; each segment with four gills, lateral gills with stalk divided near base; mesal gills consisting of single stalk, not divided. Each gill with numerous filaments attached. Segment VIII of abdomen with two gills; stalk divided at base with numerous filaments attached.

Venter of abdominal segments VIII - IX with triangular sclerotized areas; each sclerite with numerous golden brown stout setae; posterior margins of sclerites fringed with long, black setae; posteromesal section of sclerite on segment IX with small triangular area without stout setae. Sides of segment IX with pair of smaller, less sclerotized areas with black setae. Anal legs (Fig. 1) covered with long sclerite dorsally; apical end with large heavily sclerotized hook; angled ventrally 90 degress; base of hook with single heavy, long, black seta. Distal end of dorsal sclerite of anal legs with fan-like brush of extremely long, black setae; ventral surface of anal legs membranous and covered with numerous short, black hairs; some species with heavily sclerotized spine-like setae. Four anal papillae present (Fig. 1); may or may not be extruded.

SECTION 7

KEY TO KNOWN LARVAE OF THE GENERA *HYDROPSYCHE* AND *SYMPHITOPSYCHE* IN EASTERN NORTH AMERICA[1]

1 Dorsum of abdomen with minute spines on at least segments I - III (Fig. 10); scale hairs (Fig. 9-11) present on at least the last three abdominal segments. . . . . . *Hydropsyche* . . . . 12[2]

1' Dorsum of abdomen lacking minute spines; club hairs (Fig. 12) present on dorsum of abdomen; scale hairs lacking . . . . *Symphitopsyche*. 2

2 (1') Checkerboard pattern on frontoclypeus (Fig. 17). 3

2' Frontoclypeus with other patterns or unicolored. 4

3 (2) Posterior angle of frontoclypeus with three distinct spots (Fig. 20) . . . . *S. morosa* (p. 41)

3' Posterior angle of frontoclypeus with only a single large spot. . . . . . *S. bifida* (p. 30); *S. cheilonis* (p. 33)
S. walkeri (p. 35); *S. recurvata* (p. 34)
Central Form *S. bronta* (p. 37)

4 (2') Head pattern and thoracic nota black with no distinct spots or pattern on frontoclypeus 5

4' Head and thoracic sclerites yellow to bronze usually with some color pattern; if head is black, there is at least one central pale spot on the frontoclypeus 6

5 (4) Posterior portion of head brown to black with no conspicuous circular muscle scars (Fig. 22); black hairs and club hairs densely covering abdomen; club hairs distinctly thicker than regular hairs. Larva large, robust . . . *S. alhedra* (p. 45)

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[1] Based on last instar larvae; color patterns of earlier instars may be more variable.

[2] Scale hairs in *H. dicantha* may approach the appearance of club hairs, however this species like all *Hydropsyche*, possesses the minute spines on the dorsum of the abdomen. The spines under lower magnifications produce a peppered appearance, and can best be seen on uncleared specimens on the anterior and posterior margins of the segments.

5' Posterior portion of head lighter brown with numerous conspicuous circular dark brown muscle scars (Fig. 29). Black hairs and club hairs moderately dense on abdomen; club hairs only slightly thicker than regular hairs. Larvae not as large or robust . . *S. etnieri* (p. 58)

6 (4') Venter of anal legs with distinct, large, heavily sclerotized spine-like setae (Fig. 14). Head color pattern as Fig. 28. . . . . *S. piatrix* (p. 57)

6' Venter of anal legs lacking large, distinct, heavily sclerotized setae 7

7 (6') Head with three distinct stripes (Fig. 19); central stripe occasionally with yellow spot in middle; each notum with distinct anterior and posterior dark band . . . . *S. bronta* Appalachian Form (p. 37)

7' Head and thorax lacking striped color pattern. 8

8 (7') Head and thoracic sclerites with dark brown to black background color; frontoclypeus with either distinct central spot(s) or pair of diagonal spots on anterior portion of sclerite 9

8' Head and thoracic sclerites straw brown to bronze; pattern of frontoclypeus different than that above. . . . 10

9 (8) Frontoclypeus with large central yellow spot (Fig. 23) occasionally with two or three that may be fused to form longitudinal row or stripe in center of the sclerite (Fig. 24). . . . . *S. slossonae* (p. 47)

9' Frontoclypeus with no central spot(s) or central stripes; frontoclypeus with pair of diagonal spots on anterolateral part of sclerite . . . . (Fig. 21) . . . . *S. riola* (p. 44)

10 (8') Posterior half of frontoclypeus dark brown to black forming triangular mark (Fig. 25) . . . . *S. macleodi* (p. 50)

10' Posterior half of frontoclypeus not darker than rest of sclerite. 11

11 (10') Frontoclypeus with three indistinct pale spots (Fig. 26); one centrally located, others anterolateral of it. Thoracic nota with many conspicuous, thick, short bristle-like setae. Club hairs of abdomen less dense and only slightly thicker than regular hairs. Widespread, common. . . . . *S. sparna* (p. 52)

11' Frontoclypeus unicolored (Fig. 27). Thoracic nota with bristle-like setae fewer and not very conspicous. Club hairs of abdomen more dense and conspicuously thicker than regular hairs. Rare. *S. ventura* (p. 55)

12 (1) Frontoclypeus with two large upturned teeth or denticles on anterior margin (Fig. 35). 13

12' Anterior margin of frontoclypeus straight or convex; without upturned teeth. 14

13 (12) Frontoclypeus typically with large V-shaped mark (Fig. 35A); entire posterior one-fourth of head yellow; lateral and ventral aspects of of genae with little dark pigmentation, mostly yellow (Fig. 35B). . . . . *H. orris* (p. 71)

13' Frontoclypeus with two large anterolateral spots (Fig. 36A); wide dark areas adjoining epicranial arm; lateral, ventral, aspects of genae mostly dark with only a narrow yellow band behind eye (Fig. 36B). . . . . *H. bidens* (p. 75)

14 (12') Head black with distinct carina (Fig. 33A-33B). Known only from mountains of North Carolina and northern Georgia. . . . . *H. carolina* (p. 68)

14' Head variously patterned or may be black but lacks distinct carina 15

15 (14') Frontoclypeus produced into a low, wide angle (Fig. 38) . . . . *H. phalerata* (p. 78)

15' Anterior margin of frontoclypeus straight or, at most, broadly rounded. 16

16 (15') Large, conspicuous and heavily sclerotized stout setae on venter of anal legs (Fig. 14). 17

16' Large and heavily sclerotized stout setae absent from venter of anal legs. 22

17 (16) Center of anterior ventral apotome produced into a rounded tubercle (Fig. 16) best observed in lateral view. Minute spines on dorsum of abdomen reaching fourth segment on which they are very small. Head pattern as in Fig. 47. Larva extremely large. Known only from central Virginia. . . . . *H. hoffmani* (p. 98)

17' Anterior ventral apotome without large, rounded tubercle. Minute spines reaching at least to segment five. Head pattern different from Fig. 47. 18

18 (17') Numerous black, bristle-like setae on posterior half of frontoclypeus (Fig. 13). Stout spine-like setae on venter of anal legs more long and slender. Color pattern of head as in Fig. 41 . . . . *H. valanis* (p. 85)

18' Posterior half of frontoclypeus lacking conspicuous stout, bristle-like setae. Stout spine-like setae on anal legs shorter, stouter, and heavier. 19

19 (18') Head pattern as in Figs. 37 and 51. All thoracic nota pale yellow. 20

19' Head with more extensive brown pigment (Figs. 43, 50). If thoracic nota are pale yellow the pronotum is at least patterned and/or freckled with brown and darker than other thoracic nota. 21

20 (19) Stout, spine-like setae on venter of anal legs same size, shape, and color as those on ventral sclerites of ninth segment. . . . . *H. aerata* (p. 77)

20' These spine-like setae much smaller and less robust than those on venter of ninth segment . . *H. frisoni* (p. 93)

21 (19') Head pattern as in Fig. 50; anterior half of frontoclypeus with two rows of large, yellow spots; first row with three spots, second typically with four; posterior half of sclerite mottled with brown. Known only from Harpeth River, Tennessee . . . . *H. patera* (p. 104)

21' Frontoclypeus lacking two rows of pale spots anteriad (Fig. 43). . . . . *H. scalaris* (p. 87)

22 (16') Posterior angle of frontoclypeus with elevated mound or tubercle best seen in lateral or posterior view of head (Fig. 31B) 23*

22' Posterior angle of frontoclyepus level with rest of posterior half of sclerite; no mound or tubercle present (Fig. 13). 24*

23 (22) Sides of head evenly curved; head typically unicolored dark brown to black except for light area around eye (Fig. 30) and occasionally behind eye. (See diagnosis under *H. betteni*, p. 62). . . . . *H. betteni* (p. 61), ... *H. depravata* (p. 63), and *H. potomacensis* (p. 64)

23' From dorsal view sides of head constricted centrally and widened anteriad (Fig. 31); posterior area of head not as wide as anterior; head mostly dark brown with pair of large, diagonal, tear-shaped spots (Fig. 31); sides and top of head hear epicranial stem with several dark brown, oval muscle scars. . . . . *H. elissoma* (p. 65)

24 (22') Frontoclypeus with many stout, bristle-like setae conspicuous on body of sclerite; most abundant on posterior half of sclerite. 25

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*This mound or tubercle is often difficult to see, especially in the black-headed *betteni*-type species. It is best observed in dorsolateral view, and after the dorsum of the head has been cleaned of debris.

24' Bristle-like setae, if present, restricted to anterolateral corners of frontoclypeus; posterior half of sclerite may have minute, clear, spine-like setae but lacks larger bristle-like setae. 27

25 (24) Head almost entirely dark brown to black except for areas around and behind eyes (Fig. 48A); light areas behind and around eye forming a "duckling-shaped" mark (Fig. 48B); frontoclypeus with pair of small, often obscure spots mesal to tentorial pits *H. leonardi* (p.100)

25' Head not dark brown to black, either lighter brown with spots (Fig. 39), or with pattern shown in Fig. 45; no "duckling" mark on side of head; spots on frontoclypeus larger and more distinct 26

26 (25') Frontoclypeus dark brown with two pairs of distinct, subequal yellow spots (Fig. 39); top and sides of head lacking conspicuous yellow, oval muscle scars . . . . *H. dicantha* (p. 80)

26' Frontoclypeus brown with a single pair of large, less distinct yellow spots (Fig. 45); top and sides of head with numerous conspicuous, yellow, oval muscle scars . . . . *H. mississippiensis* (p. 95)

27 (24') Appressed thin, short, black setae sparse on all abdominal segments; abdomen with distinctive sheen-like appearance. Entire top and sides of head uniform bright brownish red except for fine pattern of yellowish spots (Fig. 34); frontoclypeus with pair of indistinct central spots . . . . *H. cuanis* (p. 70)

27' Appressed thin, short, black setae densely covering all segments. Color pattern unlike that of Fig. 34; frontoclypeus with or without pair of central pale spots 28

28 (27') Scale hairs sparse on at least abdominal segments I - IV (Fig. 11). 29

28' Scale hairs very abundant on all segments, may be fewer in number on segments I - II (Fig. 9-10). 31

29 (28) Entire abdomen virtually lacking scale hairs, very few found on last two segments. Frontoclypeus with two pairs of distinct, subequal yellow spots (Fig. 40); one pair centrally located, the other pair anterolateral to these; top and sides of genae with many oval yellow muscle scars encircled with dark brown pigment . . . . *H. demora* (p. 83)

29' Scale hairs on at least the last three segments. Head pattern unlike that of Fig. 40; muscle scars, if present, are solid brown. 30

30 (29') From dorsal view sides of head constricted centrally and widening anterior to this (Fig. 32); posterior portion of head not as wide as anterior portion; frontoclypeus with two large, tear-shaped spots; dorsolateral aspects of genae with numerous solid brown muscle scars. . . . . *H. decalda* (p. 66)

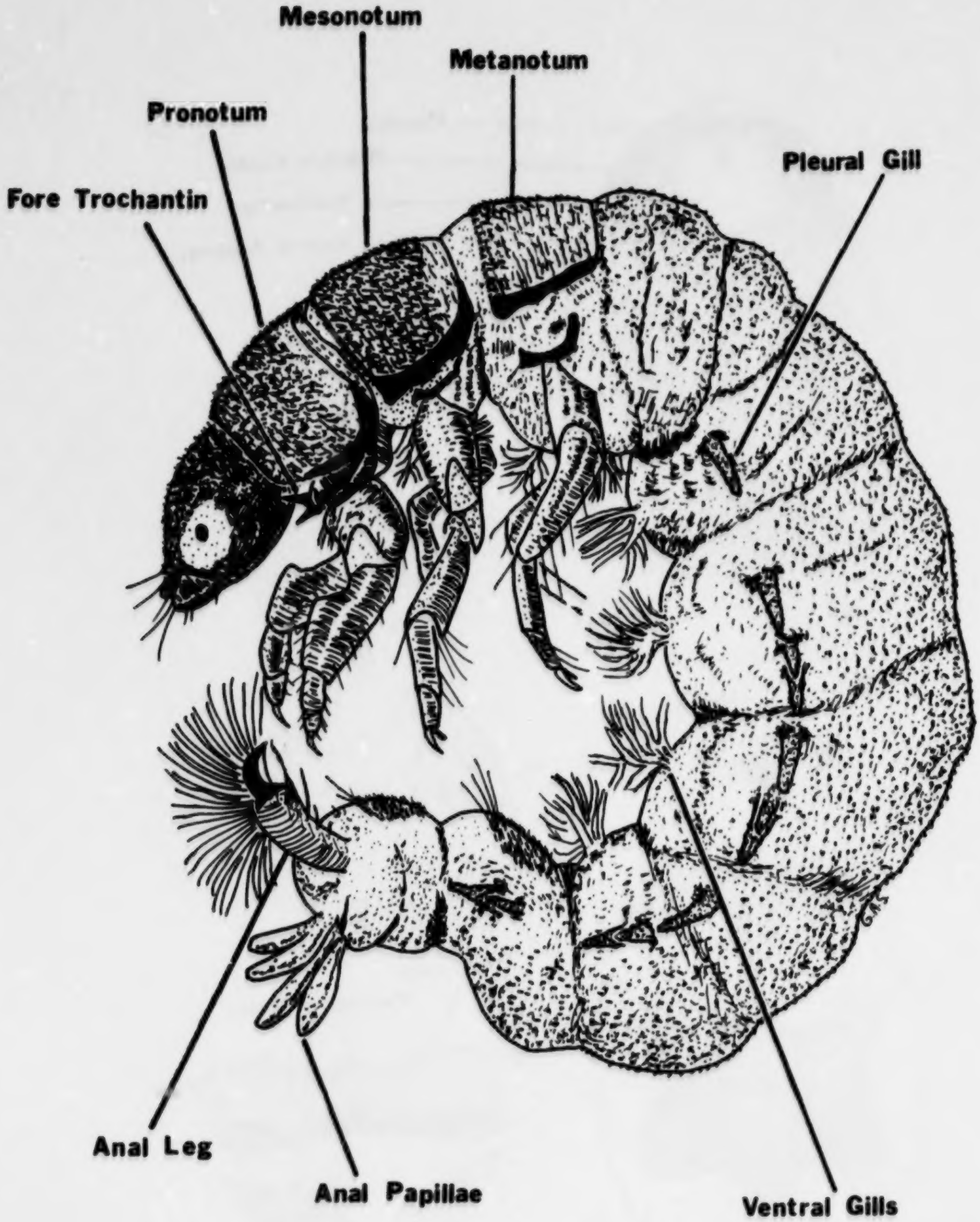
30' Sides of head evenly rounded; head only slightly wider anteriad; frontoclypeus more or less unicolored (Fig. 42); dorsolateral aspects of head iwth a few indistinct yellow muscle scars . . . . *H. arinale* (p. 86)

31 (28') Frontoclypeus with two pairs of yellow spots, one pair centrally located, the other pair anterolateral to these (Fig. 46A); spots often fused to form large, diagonal streaks on anterior portion of sclerite; posterior half of sclerite mottled; in lateral view dark area behind eye with three to four horizontal rows of yellow muscle scars curved dorsad posteriorly (Fig. 46B); dark pigment behind eye contiguous with dark pigment on venter of head . . . . *H. venularis* (p. 96)

31' Frontoclypeus with single pair of centrally located spots; yellow muscle scars behind eyes not in rows; at least a narrow yellow band separating dark pigment behind eye and that of venter of head; posterior half of frontoclypeus solid dark brown, not mottled 32

32 (31') Dorsum of head dark brown with two small, often inconspicuous spots (Fig. 49A); venter of head mostly dark brown, except for two quadrate yellow spots adjacent to gular suture; pigmentation of dorsum and venter of head separated by yellow band behind eyes to back margin of head; area around eyes yellow . . . . *H. hageni* (p. 102)

32' Frontoclypeus dark brown with pair of large, conspicuous yellow spots; large, yellow areas on ventrolateral aspects of head (Fig. 3 and 44) . . . . *H. simulans* (p. 90) and *H. incommoda* (p. 92)


Mesonotum
Metanotum
Pronotum
Pleural Gill
Fore Trochantin
G.R.S.
Anal Leg
Anal Papillae
Ventral Gills

1

Fig. 1, *Hydropsyche betteni* larvae, lateral aspect (adapted and modified from Ross, 1944).

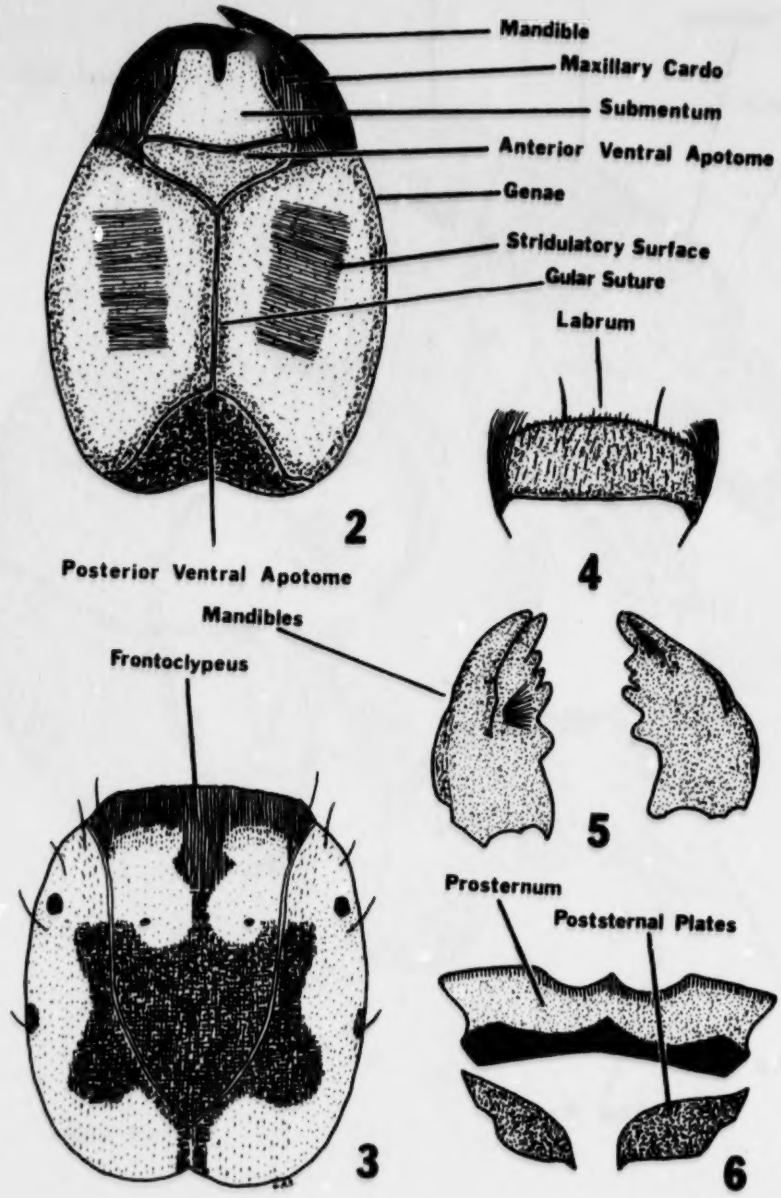

Mandible
Maxillary Cardo
Submentum
Anterior Ventral Apotome
Genae
Stridulatory Surface
Gular Suture
Labrum
2
Posterior Ventral Apotome
4
Mandibles
Frontoclypeus
5
Prosternum
Poststernal Plates
3
6

Fig. 2-6, *Hydropsyche simulans*; Fig. 2, larva, head, ventral aspect; Fig. 3, larva, head, dorsal aspect; Fig. 4, larva, labrum, dorsal aspect; Fig. 5, larva, mandibles, dorsal aspect; Fig. 6, larva, prosternum and poststernal plates.

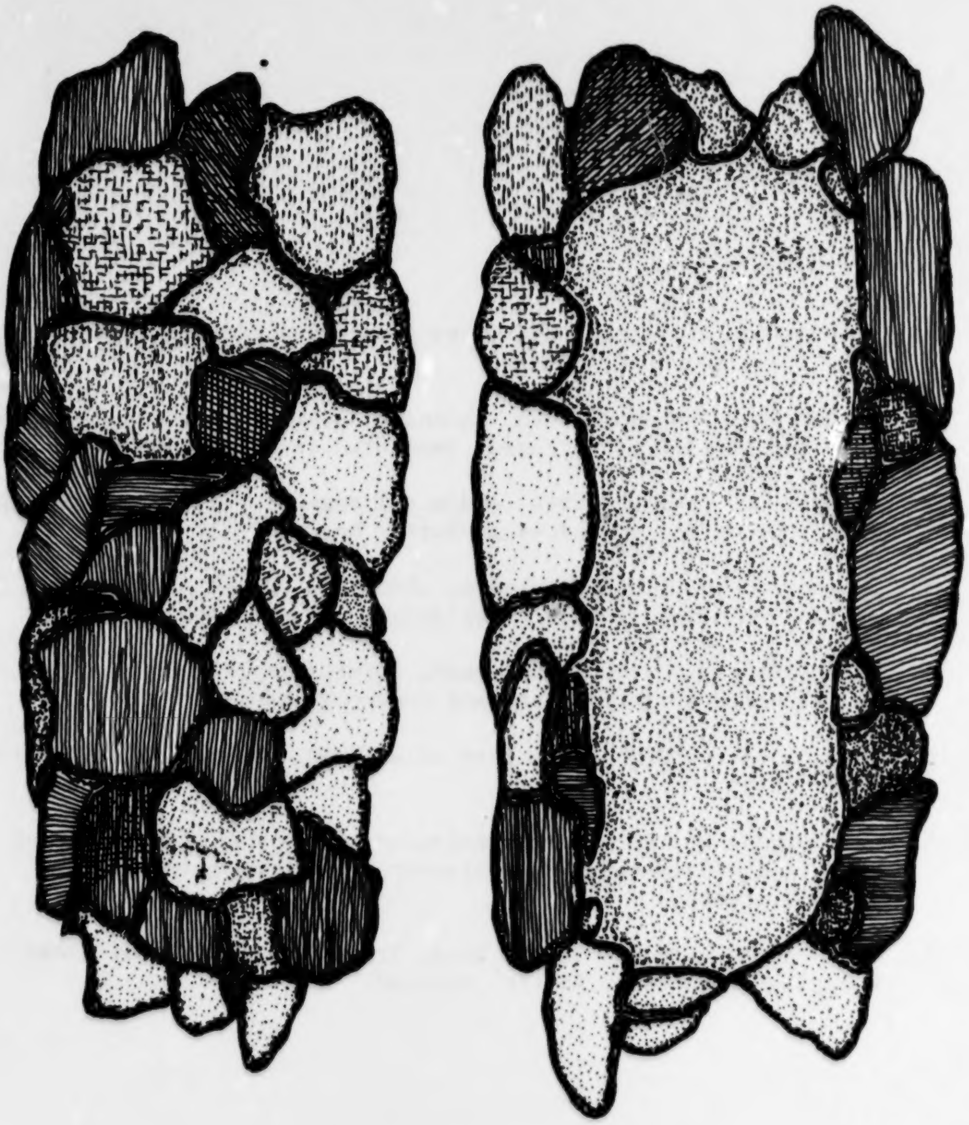


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Fig. 7 and 8, *Hydropsyche* sp.; Fig. 7, pupa, case, dorsal aspect; Fig. 8, pupa, case, ventral aspect.

Fig. 9. *Hydropsyche simulans* larva, apex of abdomen, dorsal aspect (modified from Ross, 1944).

Fig. 10. *Hydropsyche simulans* larva, abdominal segment VII, dorsal aspect, enlarged portion of epidermis (modified from Ross, 1944).

Fig. 11. *Hydropsyche arinale* larva, abdominal segment VII, dorsal aspect, enlarged portion of epidermis (after Ross, 1944).

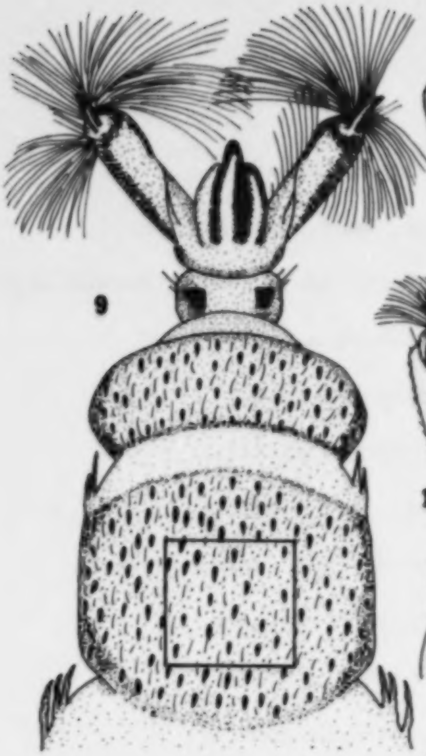
Fig. 12. *Symphitopsyche recurvata* larva, abdominal segment VII, dorsal aspect, enlarged portion of epidermis (after Ross, 1944).

Fig. 13. *Hydropsyche dicantha* larva, head, lateral aspect; arrow shows bristle-like setae on genae and frontoclypeus.

Fig. 14. *Hydropsyche aerata* larva, apex of abdomen, ventral aspect (after Ross, 1944)

Fig. 15. *Hydropsyche* sp. larva, frontoclypeus; A. dorsal aspect showing small spine-like setae on posterior portion of sclerite; B. lateral aspect.

Fig. 16. *Hydropsyche hoffmani* larva, head, lateral aspect; arrow shows tubercle on Anterior Ventral Apotome.



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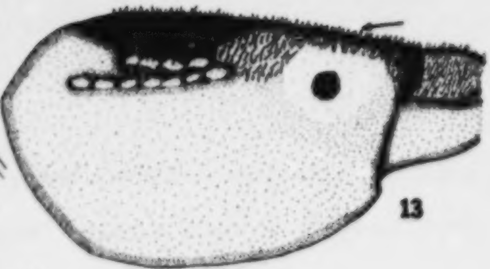

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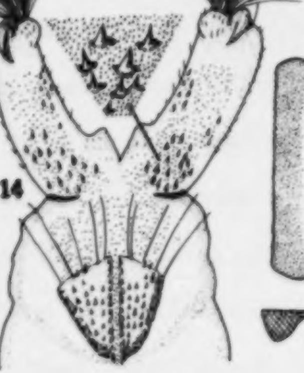

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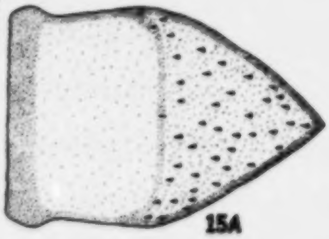

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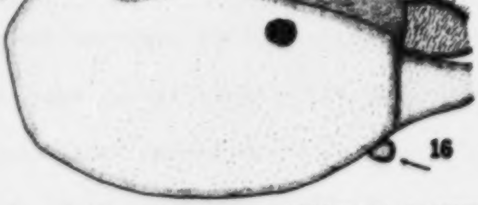

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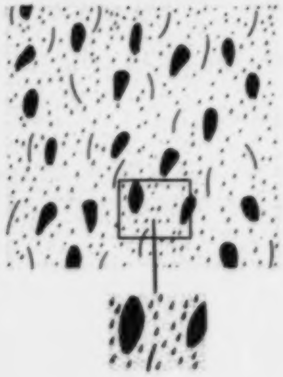

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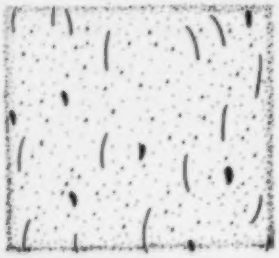

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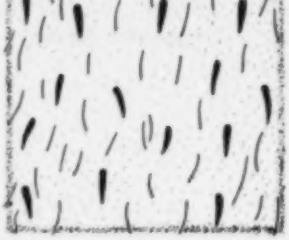


12

Fig. 17. *Symphitopsyche bifida* larva, head, dorsal aspect.

Fig. 18. *Symphitopsyche walkeri* variant larva, head, dorsal aspect.

Fig. 19. *Symphitopsyche bronta* (Appalachian Form) larva, head, dorsal aspect.

Fig. 20. *Symphitopsyche morosa* larva, head, dorsal aspect.

Fig. 21. *Symphitopsyche riola* larva, head, dorsal aspect.

Fig. 22. *Symphitopsyche alhedra* larva, head, dorsal aspect.

Fig. 23. *Symphitopsyche slossonae* larva, head, dorsal aspect.

Fig. 24. *Symphitopsyche slossonae* variant larva, head, dorsal aspect.

Fig. 25. *Symphitopsyche macleodi* larva, head, dorsal aspect.

Fig. 26. *Symphitopsyche sparna* larva, head, dorsal aspect.

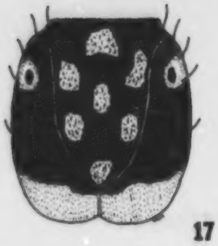
Fig. 27. *Symphitopsyche ventura* larva, head, dorsal aspect.

Fig. 28. *Symphitopsyche piatrix* presumed larva, head, dorsal aspect.

Fig. 29. *Symphitopsyche etnieri* larva, head, dorsal aspect.

Fig. 30. *Hydropsyche betteni* larva, head, dorsal aspect.

Fig. 31. *Hydropsyche elissoma* larva, head; A. dorsal aspect; B. lateral aspect, arrow showing rounded tubercle at posterior angle of frontoclypeus.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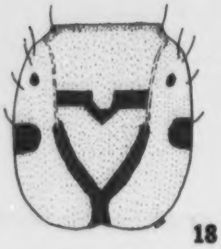
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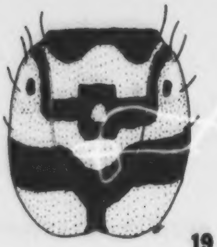
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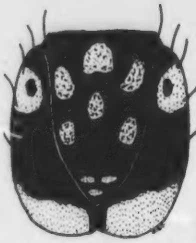
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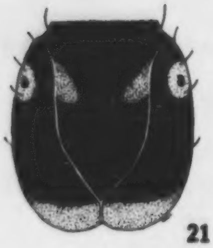
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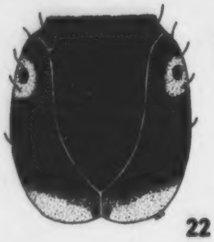
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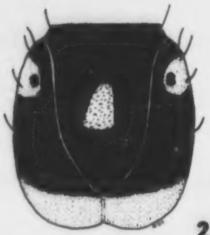
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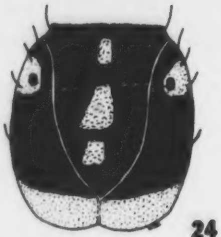
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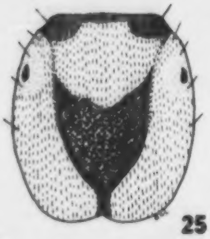
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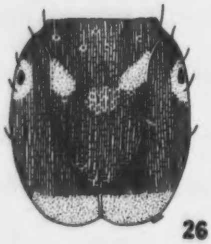
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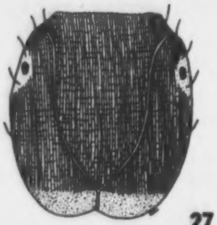
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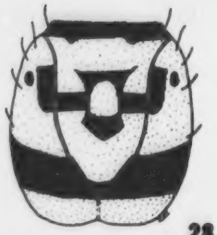
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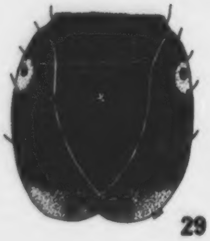
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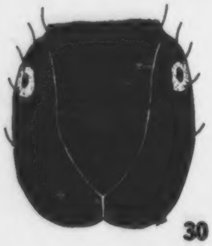
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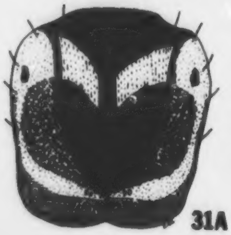
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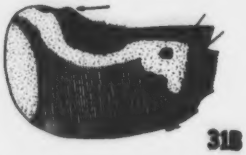

31B

Fig. 32. *Hydropsyche decalda* presumed larva, head, dorsal aspect.

Fig. 33. *Hydropsyche carolina* larva, head; A. dorsal aspect; B. dorsolateral aspect.

Fig. 34. *Hydropsyche cuanis* larva, head, dorsal aspect (after Ross, 1944).

Fig. 35. *Hydropsyche orris* larva, head; A. dorsal aspect; B. lateral aspect.

Fig. 36. *Hydropsyche bidens* larva, head; A. dorsal aspect; B. lateral aspect.

Fig. 37. *Hydropsyche aerata* larva, head, dorsal aspect.

Fig. 38. *Hydropsyche phalerata* larva, head, dorsal aspect.

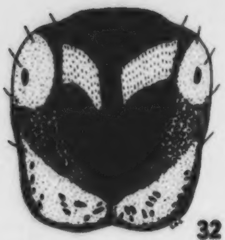
Fig. 39. *Hydropsyche dicantha* larva, head, dorsal aspect.

Fig. 40. *Hydropsyche demora* larva, head, dorsal aspect.

Fig. 41. *Hydropsyche valanis* larva, head, dorsal aspect.

Fig. 42. *Hydropsyche arinale* larva, head, dorsal aspect (after Ross, 1944).

Fig. 43. *Hydropsyche scalaris* larva, head, dorsal aspect.



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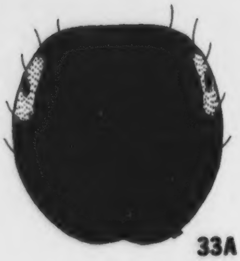

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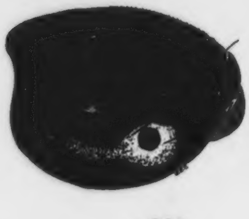

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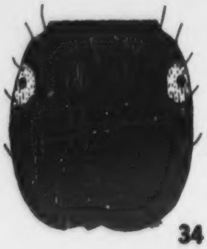

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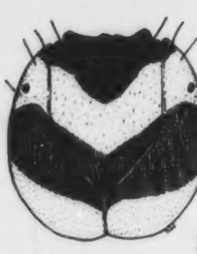

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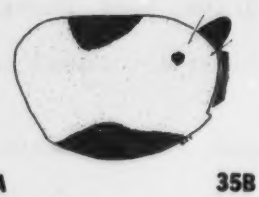

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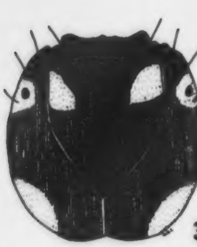

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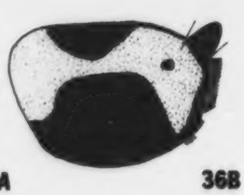

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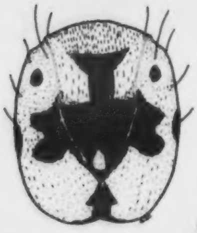

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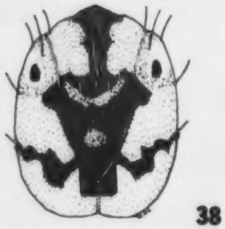

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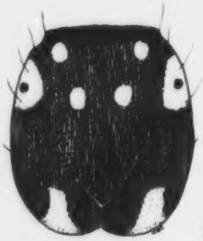

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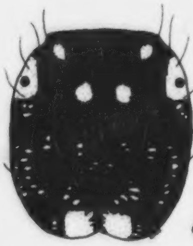

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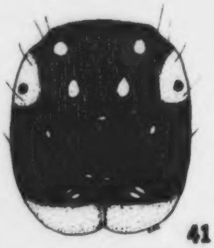

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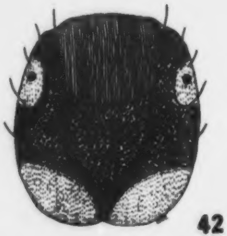

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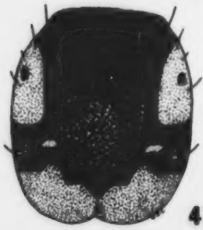


43

Fig. 44. *Hydropsyche simulans* larva, head; A. dorsal aspect; B. lateral aspect.

Fig. 45. *Hydropsyche mississippiensis* larva, head, dorsal aspect.

Fig. 46. *Hydropsyche venularis* larva, head; A. dorsal aspect; B. lateral aspect.

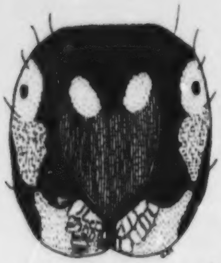
Fig. 47. *Hydropsyche hoffmani* larva, head, dorsal aspect.

Fig. 48. *Hydropsyche leonardi* larva, head; A. dorsal aspect; B. lateral aspect.

Fig. 49. *Hydropsyche hageni* larva, head; A. dorsal aspect; B. lateral aspect.

Fig. 50. *Hydropsyche patera* larva, head, dorsal aspect.

Fig. 51. *Hydropsyche frisoni* larva, head, dorsal aspect.



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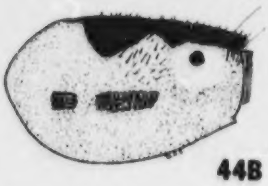

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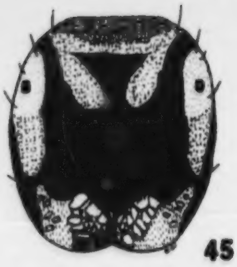

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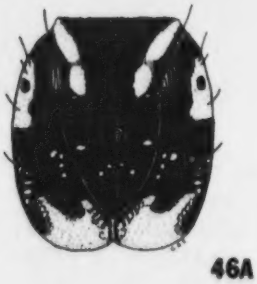

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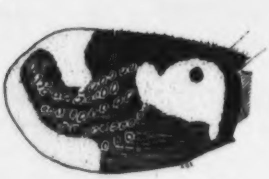

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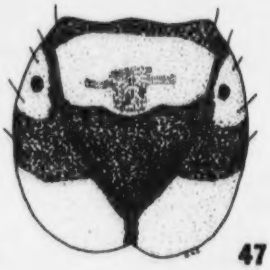

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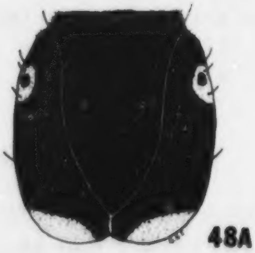

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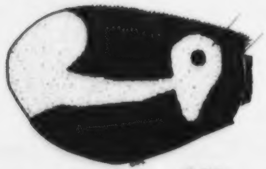

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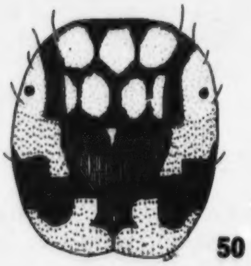

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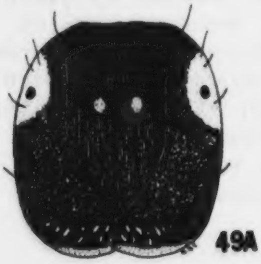

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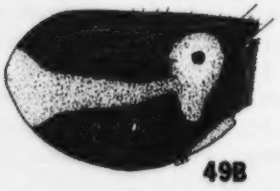

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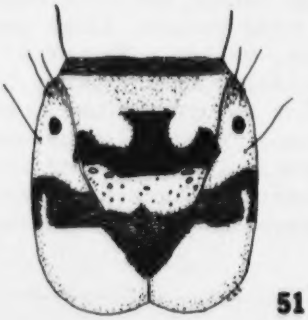

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SECTION 8

DISCUSSION OF SPECIES

The Genus *Symphitopsyche*

Symphitopsyche bifida (Banks)
(Fig. 17)

Symphitopsyche bifida (Banks), 1905. Tr. Amer. Ent. Soc., 32:15 (Type locality: "Fort Collins, Colorado").

As *Hydropsyche bifida*: Banks, 1907. Cat. Neur. Ins. U. S., p. 47; Ulmer, 1907. Gen. Ins., 60:171; Essig, 1926. Ins. W. N. Amer., p. 177; Betten, 1934. Stud. N. Am. Trich., 3:76 (As syn. of *H. chlorotica* Hagen); Ross, 1938c. Psyche, 45:16; Denning, 1943. Ent. Amer., 23:110, 112, 129-131; Ross, 1944. Ill. Nat. Hist. Surv. Bul., 23:6, 87, 91, 96, 97, 294; Leonard and Leonard 1949. Occ. Pap. Mus. Zoo. Mich., 522:9; Morse and Blickle, 1953. Ent. News, 64:71; Etnier, 1965. Ent. News, 76:146; Edwards, 1966. J. Tenn. Acad. Sci., 41:120 (All material examined were larvae; the identity is in question since no adults have ever been collected or reported from Tennessee); Corbet et al., 1966. Can. Ent., 98:1287, 1290; Longridge and Hilsenhoff, 1973. Wisc. Acad. Sci., Arts and Letters, 61:176; Nimmo, 1966. Can. Ent., 98:691.

Description

Head capsule length, 1.25 to 1.40 mm; head capsule width, 1.20 to 1.35 mm.[1] Seven spots in checkerboard pattern on frontoclypeus. Dark brown to black pigmentation on margins of genae forming epicranial arms; this pigment expanded behind eye and reaching ventrally to level of eye. Expanded black area behind eye with number of yellow spots. Posterior one-fifth of dorsum of head yellow; large area around eye and posterad of eye, ventrad of black mark, yellow. Venter of head with large, dark, inverted, Y-shaped mark on stridulatory surfaces; large, quadrate, dark brown spot located mesally around gular suture. Genae dorsolaterally with numerous stout, black bristle-like setae. Frontoclypeus shiny and lacking such setae on main body of sclerite; bristle-like setae of frontoclypeus present on anterolateral corners and posterior angle of sclerite. Labrum black, with numerous black setae; laterally fringed by brush of long, yellow setae. Mandibles dark brown.

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[1] Measurements given to facilitate recognition of last or second-to-last instar larvae.

Nota brown; pronotum slightly darker than others. Numerous stout, bristle-like setae present on all three nota. Prosternum yellow; anterior and posterior margins black; prosternal and mesosternal plates brown and moderately sclerotized. Legs brown; distal and proximal margins of first three segments black. All leg segments with numerous stout setae and longer black setae. Abdomen brown; without minute spines and scale hairs on dorsum; numerous club hairs present on dorsum of all abdominal segments and only slightly thicker than normal black hairs present. Pleural gills covered with numerous short, black hairs. Minute spines present on venter of last two abdominal segments and anal legs. Anal legs also with larger, slender, sclerotized stout setae; setae smaller, more slender, otherwise similar to stout setae on sclerotized patches of venter of segments VIII - IX.

Variation

A certain degree of variation has been observed in the larvae of *S. bifida*, and this variation relates to the number of spots on the frontoclypeus. The central five spots on the frontoclypeus are consistently present, but the medial anterior and posterior spots are variable. Some individuals of the same population may possess all seven spots, while others have only six and lack either the anterior or posterior. While still other individuals may posses only the central five and lack both the anterior and posterior spot.

Diagnosis

S. bifida is still indistinguishable from other species which have the checkerboard color pattern. No characters have yet been discovered to consistently separate *S. bifida, S. cheilonis, S. walkeri, S. recurvata,* and the Central Form of *S. bronta.*

Material Examined

Illinois:

Fox R. at Algonquin, McHenry Co., Il., 1-VII-76. D. A. Etnier (several mmts. and larvae); S. Fork Rock R. at U. S. 51, S. of Rockford, Winnebago Co., Il., 25-VIII-76. D. A. Etnier (4 mmts. and several larvae).

Minnesota:

Stoney R., at Mn. 1, Lake Co., Mn., 16-VII-75. D. A. Etnier (5 adult males, 5 mmt. males); Crow R., Watertown, Carver Co., Mn., 17-VI-75. D. A. Etnier (1 adult male, several mmts., many larvae). Crow R., Watertown, Carver Co., Mn., 27-VIII-75. D. A. Etnier (several mmts., and larvae); Mississippi R., at Fort Snelling, Dakota Co., Mn., 19-VII-75. D. A. Etnier (1 male mmt.); Saganaga Falls, Lake Saganaga, Cook Co., Mn., 3-VIII-75. D. A. Etnier (2 mmt. males and several larvae); Sunrise R., at Mn. 95, Chisago, Chisago, Mn., 6-VII-76. D. A. Etnier (several mmts. and larvae); Chippewa R., at Mn. 15, Montevideo, Chippewa Co., Mn., 8-VII-76. D. A. Etnier (several mmts. and larvae).

Wisconsin:

Eau Claire R., 2 mi. above Chippewa R., Eau Claire, Eau Claire Co., Wi., 28-VIII-75. D. A. Etnier (2 mmt. males); Eau Claire R., at Co. Rd. K., Eau Claire Co., Wi., 3-VII-76. D. A. Etnier (1 mmt. male, 7 larvae).

Ontario, Canada:

Northern Lights Rapids, Lake Saganaga, Ontario, Canada, 15-VIII-76. D. A. Etnier (6 mmts.)

Distribution

The distribution records of *S. bifida* indicate a northern range across most of North America. Published records include: British Columbia, Colorado, Illinois, Minnesota, New Hampshire, New York, Oklahoma, Ontario, Tennessee, Washington, and Wyoming.

Edwards (1966) reports this species from Tennessee; however, this record is regarded as dubious since no adults and only larvae were reported. *S. bifida* appears to be replaced in the midwest and southeast by *S. cheilonis* which inhabits rivers and streams very similar to that of *S. bifida*. In all probability, it was *S. cheilonis* that Edwards collected, rather than *S. bifida* larvae.

Biology

Symphitopsyche bifida is commonly collected in northern medium-sized streams to small rivers. These streams are typically of medium gradient with coarse gravel to small rock substrate, rich in suspended organic materials.

Pupal cases cylindrical, in shape made of coarse sand grains and small rocks. This species apparently is univoltine and Ross (1944) indicates that emergence takes place from May to August.

Remarks

Corbet et al. (1966) state: "In our opinion (*S. bifida, S. bronta,* and *S. morosa*) these three are so closely related that their status as distinct species is uncertain. Many specimens agree with Ross' drawings, but some appear intermediate. Although we recognized three categories during this work, we consider the taxonomy of these species requires critical investigation."

During the course of this work, specimens of all three species have been examined, and it is concluded that these three species are distinct. This has been supported by the larvae of the individual species involved. *S. morosa* is the most distinct of the checkerboard-patterned species on the basis of three broken spots at the posterior angle of the frontoclypeus. Metamorphotypes and larvae have been examined from a large portion of the known range of the species, and the posterior three spots have never been observed to vary. In several localities in Minnesota where *S. morosa* and *S. bifida* larvae and mature pupae have been taken sympatrically, no intermediate forms have been found in either the larvae or developing male genitalia. In the Little River in Tennessee and a number of other localities, *S. morosa* and the Appalachian Form of *S. bronta* are sympatric. Here, too, intermediate forms of either the larvae or adult genitalia have never been found. This is not to say that hybridization does not take place between these species and that intermediate forms do not exist, but it is to say that, on the basis of this work, we believe that these three species are valid.

Symphitopsyche cheilonis (Ross)

Symphitopsyche cheilonis (Ross), 1938a. Ill. Nat. Hist. Surv. Bul., 21: 149-150 (Type locality: along Salt Fork R., Oakwood, Il., 18-VII-33, Ross and Mohr).

As *Hydropsyche cheilonis*: Ross, 1944. Ill. Nat. Hist. Surv. Bul., 23: 10, 87, 91, 96, 98-99, 294; Leonard and Leonard, 1949. Occ. Pap. Mus. Zoo., Mich., 522:9; Etnier, 1973. J. Ga. Ent. Soc., 8:273; Longridge and Hilsenhoff, 1973. Wisc. Acad. Sci., Arts and Letters, 61:176; Resh, 1975. Trans. Ky. Acad. Sci., 36:12; Tarter, 1976. Limn. W. Va., p. 130.

Variation

Unlike *S. bifida*, which shows some variation in the number of spots on the frontoclypeus, *S. cheilonis* has never been observed to vary in this regard. With respect to other characters, no variation has been found in this species.

Diagnosis

Presently, *S. cheilonis* larvae cannot be distinguished from the larvae of *S. bifida*, *S. walkeri*, *S. recurvata*, and the Central Form of *S. bronta* (see Fig. 17).

Material Examined

Ohio:

Greater Miami R., at Island Pk., Dayton, Montgomery Co., Oh., 6-VII-76. G. A. Schuster (several mmts., many larvae); Stillwater R., Deweese Pk., Dayton, Montgomery Co., Oh., 6-VII-76. G. A. Schuster (several mmts., many larvae); Greater Miami R., at Island Pk., Dayton, Montgomery Co., Oh., 7-VIII-76. G. A. Schuster, F. Schuster (several mmts., many larvae).

Tennessee:

Bull Run Cr., on Tn. 162, just S. of Oak Ridge, Knox Co., Tn., 1-IV-76. G. A. Schuster, D. A. Etnier (2 male mmts., many larvae); Bull Run Cr., on Tn. 162, just S. of Oak Ridge, Knox Co., Tn., 18-IV-76. D. A. Etnier (several mmts. and larvae).

Virginia:

Craig Cr., on Va. 615, Craig Co., Va., 28-V-75. G. A. Schuster, D. A. Etnier (2 male mmts., 1 female mmt., many larvae).

Distribution

Published records of *S. cheilonis* include the following states: Illinois, Indiana, Kentucky, Michigan, Tennessee, and West Virginia. The above new distribution records from Ohio and Virginia should be added to this list.

Biology

S. cheilonis appears to be quite tolerant of high levels of suspended organic materials, for the streams from which it has been collected have high concentrations of these substances. The streams in which *S. cheilonis* has been taken have slow to moderate currents with large riffle areas. They are typically warm water streams which do not normally contain *Symphitopsyche* species. *Symphitopsyche* consists primarily of species which seem to prefer cold water to spring-like situations. *S. cheilonis* is one of the few species in this group which lives regularly in warm water streams.

The emergence period for *S. cheilonis* is from early April through September.

Symphitopsyche recurvata (Banks)

Symphitopsyche recurvata (Banks), 1914. Can. Ent., 46:253 (*H. slossonae* var.) (Type locality: "Go Home Bay, Ont., Split Rock, June 9, E. M. Walker").

As *Hydropsyche recurvata*: Sibley, 1926. Bul. Lloyd Libr., 27 Ent. Ser., 5:104; Betten, 1926. Mem. Cornell Ag. Exp. Stat., 101:524; Betten, 1934. Caddisflies N.Y. St., p. 190; Neave, 1934. Int. Rev. Hydrobiol., 31:159, 161, 169; Milne, 1936. Stud. N. Am. Trich., 3:73 (as syn. of *slossonae*); Ross, 1938. Psyche, 45:18. (descript. of type); Marshall, 1939. Ann. Ent. Soc. Am., 32:668, 671, 67a; Ross, 1941. Trans. Am. Ent. Soc., 67:93; Denning, 1943. Ent. Amer., 23:110, 112, 126-127; Milne, 1943. Can. Ent., 75:192; Ross, 1944. Ill. Nat. Hist. Surv. Bul., 23:10, 14, 87, 91, 96, 99, 294; Leonard and Leonard, 1949. Occ. Pap. Mus. Zoo., Mich., 522:10; Etnier, 1965. Ent. News, 76:146; Nimmo, 1966. Can. Ent., 98:691; Corbet et al., 1966. Can. Ent., 98:1291; Blickle and Morse, 1966. Me. Ag. Exp. Stat. Bul., 24:6; Longridge and Hilsenhoff, 1973. Wisc. Acad. Sci., Arts and Letters, 61:176.

As *Hydropsyche codona*: Betten, 1934. Caddisflies N.Y. St., p. 187; Milne, 1936. Stud. N. Am. Trich., 3:73 (as syn. of *slossonae*); Ross, 1938. Psyche, 45:18 (as syn. of *recurvata*).

Variation

The variation found in this species is similar to the variation reported by Ross (1944). He states: "Head varying from the dark checkered pattern to almost entirely yellow with a few brown markings outlining a skeleton checkerboard . . . ."

Diagnosis

This widespread species can not be separated from *S. bifida*, *S. cheilonis*, *S. walkeri*, and the Central Form of *S. bronta* on the basis of present knowledge of *Symphitopsyche* larval taxonomy (see Fig. 17).

Material Examined

Minnesota:

Stoney R., at Mn 1, Lake Co., Mn., 16-VIII-75. D. A. Etnier (5 mmts. males, 1 adult male); Mississippi R., at Fort Snelling, Dakota Co., Mn., 19-VII-75. D. A. Etnier (1 male mmt.); Saganaga Falls, Lake Saganaga, Cook Co., Mn., 3-VIII-75. D. A. Etnier (3 male mmts.); Saganaga Falls, Lake Saganaga, Cook Co., Mn., 2-VIII-75. D. A. Etnier (5 male mmts., several larvae); Sunrise R., at Mn. 95, Chisago Co., Mn., 6-VII-75. D. A. Etnier (1 male mmt., several larvae).

Ontario:

Northern Light Rapids, Lake Saganaga, Ontario, Canada, 15-VIII-76. D. A. Etnier (6 mmts.).

Wisconsin:

Eau Claire R., 2.0 mi. above Chippewa R., Eau Claire, Eau Claire Co., Wi., 28-VIII-75. D. A. Etnier (1 adult male); Eau Claire R., at Big Falls, Eau Claire Co., Wi., 3-VII-76. D. A. Etnier (4 male mmts., several larvae); Red Cedar R. at Co. Rds. M and W, 22 Mile Ford, Dunn Co., Wi., 3-VII-76. D. A. Etnier (7 mmts., numerous larvae).

Distribution

This widespread species is known from: Illinois, Manitoba, Michigan, Minnesota, New York, Ohio, Ontario, Quebec, Saskatchewan and Wisconsin.

Biology

This species is widespread and has often been recorded in the literature, yet little is known of its biology. As with all *Symphitopsyche* species, *S. recurvata* is found in riffle areas of rivers, but Ross (1944) noted that this species lives in the wave-washed areas of the Great Lakes as well. Ross also indicates that *S. recurvata* is more commonly collected in fast, cold rivers.

Ross (1944) reports this species as emerging from May to September.

Symphitopsyche walkeri (Betten and Mosely)

(Fig. 18)

Symphitopsyche walkeri (Betten and Mosely), 1940. Walker Types Trich. Br. Mus., p. 23-25 (Nov. Nom for *maculicornis* Walker) (Type locality: "St. Martin's Falls, Albany R., Hudson Bay").

As *Hydropsyche walkeri*: Ross, 1944. Ill. Nat. Hist. Surv. Bul., 23:87, 93, 96-97, 294; Leonard and Leonard, 1949. Occ. Pap. Mus. Zoo., Mich., 522: 10-11; Morse and Blickle, 1953. Ent. News, 64:71; Etnier, 1965. Ent. News, 76:146; Blickle and Morse, 1966. Me. Ag. Exp. Stat. Tech. Bul., 24:6; Nimmo, 1966. Can. Ent., 98:691; Corbet et al., 1966. Can. Ent., 98:1288, 1291; Longridge and Hilsenhoff, 1973. Wisc. Acad. Sci., Arts and Letters, 61:176.

As *H. maculicornis* Walker: Walker, 1852. Cat. Br. Mus. Neur., 1:113; Hagen, 1861. Syn., Neur. N. Am., p. 289; MacLachlan, 1863. Ent. Ann., p. 163; Hagen, 1864. Verh. Zoo. Bot. Ges., 14:823; Banks, 1892. Trans. Am. Ent. Soc., 19:367; Ulmer, 1905. J. Insbiol., 1:68; Ulmer, 1907. Gen. Ins., 60:171; Banks, 1907. Cat. Neur. Ins. U.S., p. 47; Betten, 1937. Caddis Flies N.Y. St., p. 188; Milne, 1936. Stud. N. Am. Trich., 3:73 (as syn. of *alternans*).

As Species One: Betten, 1934. Caddis Flies N.Y. St., p. 192; Betten and Mosely, 1940. Walker Types Trich. Br. Mus., p. 23 (as syn. of *walkeri*).

Variation

Specimens of *S. walkeri* collected in Virginia show no variation in the head capsule color pattern. However, specimens collected from Minnesota, especially the population from the Temperence River, possess a striking amount of variation. Individuals from this population range from the typical checkerboard color pattern to the pattern depicted in Fig. 18. In this population it appears that the latter color pattern is most prevalent. Collections of *S. walkeri* from the Baptism River site do not show this large degree of variation. Specimens from the Baptism River show the more typical checkerboard pattern and cannot be separated from the other larvae with that pattern.

Diagnosis

Symphitopsyche walkeri larvae cannot be discerned from the larvae of *S. bifida*, *S. recurvata*, *S. cheilonis*, and the Central Form of *S. bronta* (see Fig. 17).

Material Examined

Minnesota:

Temperence R., on U.S. 61, Cook Co., Mn., 21-VII-75. D. A. Etnier (5 male mmts., several larvae); Baptism R., at Finland, Lake Co., Mn., 9-VII-76. D. A. Etnier, M. A. Etnier, S. A. Etnier (1 male mmt., several larvae).

Virginia:

Roanoke R., at Dixie Caverns on U.S. 11, 10 mi. W. of Salem, Roanoke Co., Va., 28-V-75. G. A. Schuster, D. A. Etnier (1 male mmt.); Roanoke R., at Va. 419, in Salem, Roanoke Co., Va., 5-VII-75. D. A. Etnier (several larvae); Roanoke R., at Va. 419 in Salem, Roanoke Co., Va., 10-VII-76. G. A. Schuster (several male and female mmts., many larvae).

Distribution

S. walkeri has been reported from New York, Ontario, Wisconsin, and Quebec. The above Virginia collections represent a substantial increase in the range of this species.

Biology

The northern localities from which *S. walkeri* has been collected represent medium sized to small rivers. These streams typically have a medium gradient with coarse gravel to small rock substrate and are rich in suspended organic materials. Both Minnesota larval localities are trout streams. The Roanoke River locality in Virginia is very similar to the habitat described above. The locality from which most of the material has been collected in Salem, on Va. Hwy. 419, has a large riffle area in which *S. walkeri* is common. In the same riffle *S. bronta* is also present but not in the abundance of *S. walkeri*. Downstream from this riffle is a long, smooth run in which there are many large rocks on which *Hydropsyche leonardi* and *H. hoffmani* are common. *Symphitopsyche walkeri* was not collected in this area, suggesting that this species may prefer small rocks in the faster, more oxygenated riffle areas.

Published records indicate that this species emerges at least from May to August.

Symphitopsyche bronta (Ross)

(Fig. 19)

Symphitopsyche bronta (Ross), 1938a. Ill. Nat. Hist. Surv. Bul., 21: 149 (Type locality: Branson, Mi., 19-V-36, along Prairie R., Frison and Ross).

As *Hydropsyche bronta*: Denning, 1943. Ent. Amer., 23:110, 112, 125-126; Ross, 1944. Ill. Nat. Hist. Surv. Bul., 23:6, 9, 87, 91, 95, 98, 294; Leonard and Leonard, 1949. Occ. Pap. Mus. Zoo., Mich., 522:9; Etnier, 1965. Ent. News, 76:146; Blickle and Morse, 1966. Me. Ag. Exp. Sta. Bul., 24:6; Corbet et al., 1966. Can. Ent., 98:1287, 1290; Nimmo, 1966. Can. Ent., 98:691; Unzicker et al., 1970. J. Ga. Ent. Soc., 5:171; Longridge and Hilsenhoff, 1973. Wisc. Acad. Sci., Arts and Letters, 61:176; Resh, 1975. Tr. Ky. Acad. Sci., 36:12.

The species known as *Symphitopsyche bronta* presents a unique problem to the larval taxonomy of the genus. Two distinct larval forms have been collected and associated to the adult of *S. bronta*. The genitalia of both forms have been critically compared by Dr. John Unzicker with the holotype of *S. bronta*, and found to be identical. The two forms, one of which shall be called the Central Form and the other the Appalachian Form, are distinct on the larval level on the basis of coloration. The Central Form, which has been collected and associated from Ohio, Indiana, and Illinois, possesses the typical checkerboard pattern and cannot at this time be differentiated from *S. bifida*, *S. walkeri*, *S. recurvata*, or *S. cheilonis*. The Appalachian Form has been collected, associated, and reported from the Appalachian system, from New Hampshire to Tennessee and North Carolina. The Appalachian Form is a striking larva with a zebra-striped color pattern that can readily be differentiated from the Central Form. Adult genitalia of these two forms have been extensively examined and compared, and no characters have yet been observed to separate them consistently. The larvae are distinct and intermediates of the two forms have never been collected. It is quite possible that this situation represents two sibling or cryptic species which cannot be separated at the adult level but are easily discriminated in the larval stage. It is unfortunate that insufficient material has been available for study to state with certainty whether this is the case or not. The situation requires further study, and a great amount of material must be examined before a definitive statement is possible. For this reason, the two forms are treated as such rather than distinct species or even subspecies.

It is our feeling that the critical study areas include Kentucky, New York, Ohio, and Pennsylvania--states in which an overlap of these two forms may occur. Furthermore, an attempt to determine the distribution of each form on the basis of published records, for which identification was based on adult genitalia, is very difficult. For example, Resh's (1975) records from Kentucky cannot be termed either the Central or Appalachian Form since Kentucky lies in a very critical area of possible overlap of these two forms. Except for Resh (1975) and Blickle and Morse (1966), all the published records are from areas in which the Central Form is expected. Blickle and Morse (1966) present the only published record of what may possibly be the Appalachian Form.

a. The Central Form of *S. bronta*

Variation

Only a limited number of these larvae were available for study, and, therefore, very little can be concluded regarding variation in this form. However, Ross (1944) states: "In coloration similar to *bifida*, especially with reference to the checkered type of pattern on the head. As with *bifida*, there is considerable variation in the details of this pattern."

Diagnosis

Because the larva of this form is indistinguishable from *S. bifida*, *S. walkeri*, *S. recurvata*, and *S. cheilonis*, the reader is referred to the description of the larva of *S. bifida*, page 30 (see Fig. 16).

Material Examined

Illinois:

Quiver Cr., Havana, Mason Co., Il., 29-V-36. C. O. Mohr (1 male and 1 female mmt.); Quiver Cr., Havana, Mason Co., Il., 29-V-36. Mohr and Burks (1 male mmt. and 4 larvae); White Pine Pk., Ogle Co., Il., 30-V-36. H. H. Ross (4 female mmts., 7 larvae); Apple R., Canyon St. Pk., Jo Daviess Co., Il., 2-III-38. Ross and Mohr (7 larvae).

Distribution

Because so few metamorphotypes and associated larvae are available, it is extremely difficult to present an accurate range for the Central Form of *S. bronta*. Personal communications with a number of workers (E. McElravy, Ohio; S. Newhouse, Indiana; V. Resh, Indiana) indicate that they have collected only the checkerboard form of *S. bronta* in their areas. Also, the junior author, who has undertaken extensive study in both Minnesota and Wisconsin, has never encountered striped *Symphitopsyche* larvae from either of these two states from which *S. bronta* has been reported. It is our contention that the Central Form is widespread throughout the midwestern states. However, a great deal of additional associated larval material is necessary to substantiate this statement.

Biology

Ross (1944) makes these comments concerning the Illinois collections of *S. bronta*: "In Illinois this species is restricted with few exceptions to small medium sized streams in northern Illinois. Most of these are spring fed; all are permanent. The adults emerge from April to the latter part of August."

b. The Appalachian Form of *S. bronta*

Variation

The only variation that has been observed in this form is the presence or absence of a central spot in the intermediate band on the head. The degree of distinctiveness of the dark banding is also slightly variable, and the bands may fade to a certain extent after being stored in alcohol for a long period of time. This variation is intra-populational, and has been found in most populations studied.

Diagnosis

The Appalachian Form of *S. bronta* differs from the Central Form only by its consistent striped head pattern. No other characters have been found to distinguish this form of *S. bronta* from the Central Form or from the other checkerboard-patterned species. Therefore, the description of the larva of *S. bifida* (page 30) should be referred to for comments regarding characters other than the color pattern.

The unique color pattern of the Appalachian Form consists of distinct stripes on the head and nota (Fig. 19). There are typically anterior, intermediate and posterior dark bands on the head. The medial band on occasion has a central yellow spot. Each notum also possesses distinct dark bands on the anterior and posterior margins.

The background color for the head and thoracic sclerites is straw yellow, contributing to the distinctiveness of the stripes. No specimens of the Appalachian Form have ever been collected which have a pattern approaching that of the checkerboard pattern.

Material Examined

Maryland:

Flint Stone, Allegany Co., Md., 19-IV-38. H. H. Ross (1 male mmt.).

North Carolina:

Shoal Cr., on U.S. 441, 1.0 mi. S. of Cherokee, Jackson Co., N.C., 1-V-76. G. A. Schuster (6 larvae); Oconaluftee R., at Cherokee, Swain Co., N.C., 27-VI-76. D. A. Etnier (1 larva).

Tennessee:

Little R., 2.0 mi. above Townsend, Blount Co., Tn., on Tn. 73, 14-VIII-73. M. Hughes, W. Dickinson, G. A. Schuster (several larvae); Little Pigeon R., 1.0 mi. S. of Richardson Cove on Co. Rd. 2421, Sevier Co., Tn., 21-VI-75. G. A. Schuster (6 larvae); Little R., at Townsend, Blount Co., Tn., on Tn. 73, 19-VI-75. M. Hughes, W. Dickinson, G. A. Schuster (2 male mmts., 12 larvae); Cox Property, East Slope of Webb Mtn., Sevier Co., Tn., 24-I-75. R. Smith, M. Warren, K. Cottrell (3 larvae); W. Prong Little Pigeon R., above Gatlinburg, Sevier Co., Tn., in Great Smoky Mtn. Nat. Pk., 17-I-76. L. and W. Starnes (4 larvae).

Virginia:

Roanoke R., at Wayside Park, 10 mi. above Salem on U.S. 11, Roanoke Co., Va., 5-VII-75. D. A. Etnier (1 male mmt., 7 larvae); Roanoke R., at Va. 419 in Salem, Roanoke Co., Va., 5-VII-75. D. A. Etnier (several larvae); North Fork Holston R., at Saltville, Va., below sludge ponds, VII-75. TVA (5 larvae); Roanoke R., at Va. 419 in Salem, Roanoke Co., Va., 10-VII-76. G. A. Schuster (several mmts. and larvae).

Distribution

The exact range of the Appalachian Form of *S. bronta* is unknown, but it is believed to be restricted to drainages originating in the mountain system from New Hampshire to the Carolinas and Tennessee. Dr. Oliver Flint (U.S.N.M.) has informed us that he has collected this larva as far north as New Hampshire, and Mr. Justin Frost (Rowe, Mass.) has indicated that he has collected this larva on a number of occasions in the Deerfield River drainage system in Massachusetts.

Biology

These striped larvae have been collected in a variety of habitats in North Carolina, Tennessee, and Virginia. The above collections from the Little River and West Prong of the Little Pigeon River in East Tennessee represent localities which can be considered cold mountain streams—brown and rainbow trout waters. Contrasting with this, Shoal Creek in North Carolina, from which larvae have also been collected, is a very small creek (1 meter wide) with a heavy suspended organic load and warm water in the summer months.

The emergence period for this form of *S. bronta* appears to be from April to August.

Symphitopsyche morosa (Hagen)
(Fig.20)

Symphitopsyche morosa (Hagen), 1861. Syn. Neur. N. Am., p. 287 (Type localities: "St. Lawrence R., Can.; Washington (Osten Sacken); N. Red R. (Kennicott); Trenton Falls, N.Y. (Osten Sacken)").

As *Hydropsyche morosa*: 1873. P. Boston Soc., 15:297; Ulmer, 1907. Gen. Ins., 60:171 (as syn. of *alternans*); Milne, 1936. Stud. N. Am. Trich., 3:71, 73; Ross, 1938. Psyche, 45:16; Brimley, 1938. Ins. N. Carolina, p. 252; Betten and Mosely, 1940. Walker Types Trich. Br. Mus., p. 21-31; Denning, 1943. Ent. Amer., 23:110, 112, 127-129; Ross, 1944. Ill. Nat. Hist. Surv. Bul., 23:91, 96, 98, 294; Leonard and Leonard, 1949. Occ. Pap. Mus. Zoo., Mich., 522:10; Morse and Blickle, 1953. Ent. News, 64:71; Etnier, 1965. Ent. News, 76:146; Nimmo, 1966. Can. Ent., 98:691; Corbet et al., 1966. Can. Ent., 98:1287, 1290; Blickle and Morse, 1966. Me. Ag. Exp. St. Tech. Bul., 24, p. 6; Longridge and Hilsenhoff, 1973. Wisc. Acad. Sci., Arts and Letters, 522:176; Resh, 1975. Trans. Ky. Acad. Sci., 36:12; Tarter, 1976. Limn. W. Va., p. 130.

As *Hydropsyche chlorotica* Hagen: Hagen, 1861. Syn. Neur. N. Am., p. 290; Hagen, 1864. Verh. Zool. Bot. Ges., 14:821; Banks, 1892. Trans. Am. Ent. Soc., 19:367; Banks, 1907. Cat. Neur. Ins. U.S., p. 47; Ulmer, 1907. Cat. Coll. Seys 6, 1:64-65; Ulmer, 1907. Gen. Ins., 60:171; Banks, 1908. Proc. Ent. Soc. Wash., 9:155; Betten, 1926. Mem. Cornell Ag. Exp. Stat., 101:524; Betten, 1934. Caddis Flies N.Y. St., p. 7, 186-187; Neave, 1934. Int. Rev. Hydrobiol., 31:169; Milne, 1936. Stud. N. Am. Trich., 3:70, 72, 723; Brimley, 1938. Ins. N. Carolina, p. 251; Ross, 1938. Psyche 45:16 (as syn. of *morosa*).

Description

Head capsule length, 1.30 to 14.0 mm; width, 1.10 to 1.25 mm. Frontoclypeus with checkerboard color pattern (Fig. 20); posterior corner of frontoclypeus always with a cluster of three smaller yellow spots. Posterior one-fourth of head yellow; remainder of dorsal surface of head with dark brown to black background color. Ventral surface of head mostly yellow with wide, dark, inverted Y-shaped marks below each eye, and black bordering the ventral gular sutures. Genae covered dorsally and laterally with stout black setae to posterior corner of frontoclypeus. Frontoclypeus devoid of such setae except for anterolateral corners. Labrum dark brown to black, covered dorsally by black setae with lateral fringe of straw colored hairs. Nota covered with short, black setae; as dark as head, except for yellowish spot on lateral edges of pronotum. Legs straw to brown in color. All leg segments liberally covered with short spine-like setae; anterior femur with black setal fringe on mesial border. Prosternum anteriorly edged in black with wide, black band posteriorly; remainder yellow. Poststernal plates solid, dark brown. Abdomen brownish, covered with short, black setae and club hairs; club hairs lacking below lateral line. Dorsal sclerite of anal legs covered with black setae; ventrally, anal legs covered by sharp, golden spine-like setae.

Variation

Like several other *Symphitopsyche* species with the checkerboard color pattern, *S. morosa* exhibits considerable variation of this pattern. All the variations we have observed in this species have been in larvae collected in Minnesota or Wisconsin. Variations observed in northern material are: (1) a much lighter colored head and nota, (2) the venter of the head lacks dark pigmentation, (3) the anterior three or four light spots on the frontoclypeus are often fused to form large yellow areas on that sclerite.

Even though considerable variation exists in some populations, we have always been able to identify *S. morosa* on the basis of the three small spots on the posterior corner of the frontoclypeus. We have examined a considerable number of *S. morosa* larvae from many populations and have found the only variation in this character is that, on rare occasion, there may be only two small spots rather than three. Otherwise, this character has proven to be reliable in the identification of the *H. morosa* larvae.

Diagnosis

At first glance, this species fits the checkerboard color pattern attributed to several *Symphitopsyche* species. However, *S. morosa* can be consistently distinguished by the presence of the three small spots clustered in the posterior corner of the frontoclypeus (Fig. 20). No other checkerboard-patterned *Symphitopsyche* species exhibits these spots. In all of the other species, if any marking is present in the posterior corner of the frontoclypeus, it is a single, large, yellow spot (Fig. 16).

Material Examined

Minnesota:

Temperence R., at U.S. 61, Cook Co., Mn., 21-VII-75. D. A. Etnier (several mmts. and larvae); Mississippi R., at Fort Snelling, Dakota Co., Mn., 19-VII-75. D. A. Etnier (1 male mmt.); Temperence R., at U.S. 61, Cook Co., Mn., 31-VII-75. D. A. Etnier (several mmts. and larvae); Devil's Track R., at U.S. 61, Cook Co., Mn., 13-VIII-75. D. A. Etnier (many larvae); Sunrise R., at Mn. 95, Chisago Co., Mn., 6-VII-76. D. A. Etnier (1 male mmt.).

North Carolina:

Panther Dr., at Fines Cr. exit, Haywood Co., N.C., 24-V-75. D. A. Etnier and G. A. Schuster (2 male mmt.); Shoal Cr., on U.S. 441, 1 mi. S. of Cherokee, Jackson Co., N.C., 1-V-76. G. A. Schuster (2 larvae); Oconluftee R., at Cherokee, Swain Co., N.C., 27-VI-76. D. A. Etnier (1 larva).

Tennessee:

Little R., 4-5 mi. N. of Townsend, Blount Co., Tn., on Tn. 73, 19-VII-74. M. Hughes, R. Smith, G. A. Schuster (numerous larvae); Little R., off Tn. 73 at Townsend, Blount Co., Tn., 27-VII-74. M. Hughes, R. Smith, G. A. Schuster (4 male mmts., 1 female mmt.); Little Pigeon R., off Tn. 2421 at Richardson Cove, Sevier Co., Tn., 10-VII-74. C. and G. A. Schuster (many larvae); Little R., at U.S. 411 bridge, Blount Co., Tn., 24-VI-74.

C. and G. A. Schuster (1 male mmt.); Little R., 1.5 mi. S. of jct. River Rd. and U.S. 411, Bount Co., Tn., 18-IV-75. G. A. Schuster (1 male mmt.); Little R., 2 mi. above Townsend, Blount Col, Tn., 14-VII-75. M. Hughes, W. Dickinson, G. A. Schuster (2 female mmt., many larvae); Little Pigeon R., 1 mi. S. of Richardson Cove on Co. Rd. 2421, Sevier Co., Tn., 21-VI-75. G. A. Schuster (7 larvae); Little R., at Townsend on Tn. 73, Blount Co., Tn., 19-VI-75. M. Hughes, W. Dickinson, G. A. Schuster (many larvae); Nolichucky R., at Solomon Island off unnamed Co. Rd., approx. 12.5 mi. N. of Newport, at Cocke and Green Co. line, 26-X-75. D. A. Etnier (2 larvae).

Virginia:

New R. below U.S. 460 bridge, Giles Co., Va., 29-V-75. D. A. Etnier, G. A. Schuster (1 male, 3 larvae); James R., at Peters Cr. on Va. 501, Bedford Co., Va., 30-VIII-76. D. A. Etnier, G. A. Schuster (3 mmts., several larvae).

Wisconsin:

Red Cedar R., at Co. Rd. M and W, 22 Mile Ford, Dunn Co., Wi., 3-VII-76. D. A. Etnier (2 male mmts.).

Distribution

This species is widespread across the northeastern U.S. and southeastern Canada. In recent years it has also been found to be widespread in the southeastern U.S., roughly following the Appalachian Mountains south. Its range includes the following: Maine, Manitoba, Michigan, Minnesota, New Hampshire, New York, North Carolina, Ontario, Quebec, Tennessee, Virginia, West Virginia and Wisconsin.

Biology

This species is commonly collected in medium-sized rivers, those typified as small-mouth bass streams. We have collected *S. morosa* from many localities on the Little River, which has its origins high in the Great Smoky Mountains, and drains into Fort Loudon Reservoir (Tennessee River). It seems to be absent from the higher elevations where *S. slossonae* and *S. alhedra* are common. The habitat there can be characterized as trout waters with large, smooth boulders. It is commonest in the middle portions of the river where there are large riffle areas and where the substrate consists of small- to medium-sized rocks covered with *Podostemum* sp. Its pupal cases are most often attached to strands of *Podostemum* where they are completely cylindrical in shape. Otherwise, the cases are attached directly to the rock surfaces. *Symphitopsyche morosa* is uncommon in the lower reaches of the Little River where the habitat is more like that of a large river with a high silt and suspended particle load. Other rivers where we have collected *S. morosa* follow the general description of the Little River of Tennessee and have similar habitats.

Collection records indicate that this species univoltine, emerging from April through September.

Symphitopsyche riola (Denning)
(Fig. 21)

Symphitopsyche riola (Denning), 1942. Can. Ent., 74:49 (Type locality: Nine Mile Cr., Hennepin Co., Mn., 5-V-37. D. G. Denning).

As *Hydropsyche riola*: Denning, 1943. Ent. Am., 23:133-134; Ross, 1944. Ill. Nat. Hist. Surv. Bul., 23:294; Ross and Spencer, 1952. Ent. Soc. B.C., Proc., 48:46; Etnier, 1965. Ent. News, 76:146; Longridge and Hilsenhoff, 1973. Wisc. Acad. Sci., Arts and Letters, 61:176.

Description

Head capsule length, 1.35 to 1.40 mm; width, 1.15 to 1.20 mm. Anterodorsal four-fifths of head dark brown; frontoclypeus with large triangular anterolateral pale spots; often with a more inconspicuous central subtriangular spot. Area around eyes and directly posterior to them and posterior one-fifth of head yellow. Venter of head with large, brown, pigmented areas covering stridulatory surfaces, and around geneal sutures. Genae adorned dorsolaterally with stout, short, black setae. Anterolateral corner and margins of frontoclypeus bordering genae with scattered stout black setae; rest of sclerite devoid of such setae. Labrum dark brown and covered with short, black setae; laterally margined with tuft of long, yellow setae. Mandibles uniformly dark brown. Thoracic nota dark brown; pronotum with large lateral area slightly lighter in color than rest of sclerite. Each nota covered with short, black setae and margined laterally in black. Legs uniformly colored dark brown, and abundantly covered with short, golden spine-like setae. Abdomen beige, covered with short, black hairs. Club hairs present on dorsum of abdomen as well as below the lateral line; not greatly thicker than other hairs. Dorsal sclerite and ventral surface of anal legs covered with short, black setae.

Variation

The major variation observed in this species is the amount of contrast of the central spot located on the frontoclypeus. It is often completely obscure while in other larvae it is as conspicuous as the anterolateral spots. This variation must be kept in mind when keying this larva. There is also some variation in the degree of contrast of the anterolateral spots. However, this is not as great as in the central spot; the anterolateral spots are always conspicuous.

Diagnosis

This species is easily recognized by its dark brown coloration and the pair of conspicuous triangular marks on the frontoclypeus. However, some specimens may have an additional central spot on the frontoclypeus which may lead to some confusion between this species and *S. sparna*. These two species may be separated on the basis of: (1) The nota and all leg and head sclerites are much darker in *S. riola* than in *S. sparna*; the sclerites of *S. sparna* are consistently golden to reddish brown in color; whereas, those of *S. riola* are very dark brown--almost black. (2) Due to the dark pigmentation of *S. riola*, the spots on the frontoclypeus have much greater contrast with the background than those of *S. sparna* which are often obscured. (3) The abdomen of *S. riola* is darker than that of *S. sparna* as well as covered by many short, black hairs.

Material Examined

Minnesota:

Middle Fork Whitewater R., at Mn. 74 bridge, 2 mi. S. of Elba, Winona Co., Mn., 24-VIII-76. D. A. Etnier and family (numerous mmts. and many larvae).

Distribution

This species is widespread across the northern sections of North America. Published records include locales from the following states: Minnesota and Wisconsin and from British Columbia.

Biology

Little can be said of the biology of *S. riola* since it has not often been collected or studied. The larvae and metamorphotypes are from the Middle Fork of the Whitewater River in Minnesota, which is a medium-size trout stream. The bottom consists primarily of coarse gravel and sand.

Published adult collection data indicate that this species emerges from April to September.

Remarks

The genus *Symphitopsyche* is presently being revised worldwide at the adult level by Drs. J. D. Unzicker and H. H. Ross. Dr. Unzicker, in personal communications, and the junior author, have indicated the possibility that *H. riola* and *H. alhedra* are synonyms. However, based on the distinctiveness of the larvae of both forms, they are treated here as distinct species until this question can be resolved.

Symphitopsyche alhedra (Ross)
(Fig. 22)

Symphitopsyche alhedra (Ross), 1939. Proc. Ent. Soc. Wash., 41:67 (Type locality: Black Gap, N.C., 24-IV-38, Ross and Burks).

As *Hydropsyche alhedra*: Brimely, 1942. Ins. N. Carolina, p. 15.

Description

Head capsule length, 1.65 to 1.80 mm; width, 1.45 to 1.60 mm. Head coal black except for circular areas around the eyes and large subrectangular yellow area on posterior lateral aspects of genae. Genae and frontoclypeus very shiny. Genae with stout, black setae dorsally especially along frontoclypeus; some setae on lateral aspects of genae. Frontoclypeus with such setae in anterolateral corners and at posterior angle; rest of frontoclypeus devoid of these. Labrum coal black with short, black setae; laterally margined by tuft of long, yellow setae. Mandibles dark brown to black. Thoracic nota dark brown to black each adorned with numerous short, black setae similar to those found on head. Each nota laterally margined in black. Prosternum mostly dark brown to black, laterally gold; poststernal plates brown. Dorsum of abdomen also with numerous club hairs, few of which are located below the pleural gills. Dorsal sclerite of anal legs covered with short black setae. Ventral aspects of anal legs also covered with such setae.

Diagnosis

This species may be separated from other *Symphitopsyche* species on the basis of head capsule coloration. Only one other species, *S. etnieri* from Grainger County, Tennessee, has similar coloration. These two species can be reliably separated by: (1) The posterior dorsal one-fifth of the head is slightly lighter in color than the rest of the head in *S. etnieri*, and located in this area are numerous circular dark brown muscle scars (Fig. 29). These muscle scars are absent in *S. alhedra*. (2) The abdomen of *S. alhedra* is densely covered with black hairs and numerous club hairs. The abdomen of *S. etnieri* has considerably less hairs, especially on the ventral surfaces, and the hairs are thinner and shorter. (3) The club hairs on the abdomen are thicker and more conspicuous in *S. alhedra*. (4) The average head length of *S. alhedra* is .35 mm longer than *S. etnieri* and the width is .22 mm wider. In general, *S. alhedra* is more robust and larger than *S. etnieri*.

Material Examined

Tennessee:

Middle Prong of Little R., at Tremont, Great Smoky Mtn. Nat. Pk., Blount Co., Tn., 18-XI-75. W. C. Dickinson, G. A. Schuster (6 larvae); Middle Prong of Little R., at Tremont, Great Smoky Mtn. Nat. Pk., Blount Co., Tn., 19-III-76. G. A. Schuster (2 larvae); Hills Cr., on Tn. 73 between Gatlinburg and Cosby, Sevier Co., Tn., 11-IV-76. D. A. Etnier (3 male and 1 female mmts.); Middle Prong of Little R., at Tremont, Great Smoky Mtn. Nat. Pk., Blount Co., Tn., 7-IV-76. W. C. Dickinson, G. W. Wolfe, G. A. Schuster (several larvae).

Distribution

The only published record of this species is the description of the holotype from Black Gap, N.C. Listed above are two additional localities from which either larvae or mature pupae were collected.

Biology

Little is known of the biology of *S. alhedra* since it has been rarely collected. However, it is commonly encountered in the Middle Prong of the Little River at Tremont in the Great Smoky Mountains National Park. The river at this point is 12 to 15 meters wide and 0.2 to 1.0 meters in depth. Shore vegetation includes primarily rhododendron and shrubs. The river bottom consists of large- to medium-size boulders with little vegetation; current is moderate to fast. The water is clear with very little turbidity and has fairly low temperatures year round. The river may be classified as a brown and rainbow trout stream at this location.

The larvae inhabit the faster, white-water areas which makes collecting difficult. Their larval retreats are often closely associated with those of *Arctopsyche irrorata* Banks. Because the boulders are so large and the current so fast, collecting *S. alhedra* is best done by running one's fingers over the surfaces of the rocks while steadying oneself in the current.

Caddisflies found to be sympatric with *S. alhedra* are: *Brachycentrus spinae*, *B. lateralis*, *Lepidostoma* spp., *Dolophilodes distinctus*, *Symphitopsyche bronta*, *S. sparna*, *S. slossonae*, *Arctopsyche irrorata*, *Diplectrona modesta*, and *Parapsyche apicalis*.

Symphitopsyche alhedra appears to have one emergence per year. Mature larvae have been collected during the winter months with few mature larvae collected after April. Emergence occurs during April.

Remarks

See "Remarks," *S. riola*, page 45.

Symphitopsyche slossonae (Banks)
(Fig. 23 and 24)

Symphitopsyche slossonae (Banks), 1905. Trans. Amer. Ent. Soc., 32:14 (Type locality: "Franconia, New Hampshire (Mrs. Slosson)").

As *Hydropsyche slossonae*: Banks, 1907. Cat. Neur. Ins. U.S., p. 47; Ulmer, 1907. Gen. Ins., 60:171; Banks, 1908. Psyche, 15:61, 65; Betten, 1934. Caddis Flies N.Y. St., p. 185 (as syn. of *alternans*); Milne, 1936. Stud. N. Am. Trich., 3:69, 72, 73; Ross, 1938. Psyche, 45:18; Brimley, 1938. Ins. N. Carolina, p. 252; Howell, 1939. J. Elisha Mitch. Soc., 55:327; Ross, 1941. Trans. Am. Ent. Soc., 67:92; Denning, 1943. Ent. Am. 23:110, 112, 113, 131-133; Ross, 1944. Ill. Nat. Hist. Surv. Bul., 23:8, 14, 87, 88, 96, 99, 294; Leonard and Leonard, 1949. Occ. Pap. Mus. Zoo., Mich., 522:10; Morse and Blickle, 1953. Ent. News, 64:71; Ellis, 1962. Occ. Pap. Mus. Zoo., Mich., 624:8; Etnier, 1965. Ent. News, 76:146; Edwards, 1966. J. Tenn. Acad. Sci., 41:121; Blickle and Morse, 1966. Me. Ag. Exp. Stat. Tech. Bul., 24:6; Unzicker et al., 1970. J. Ga. Ent. Soc., 5:172; Longridge and Hilsenhoff, 1973. Wisc. Acad. Sci., Arts and Letters, 61:176.

Description

Head capsule length, 1.45 to 1.60 mm; head capsule width, 1.25 to 1.35 mm. Dorsum of head dark brown to black with one to three pale yellow spots on frontoclypeus. If two or three yellow spots present, they are always in a longitudinal row. Posterior one-third of dorsum of head yellow. Dark pigmentation of head ends just posterior to hind corner of frontoclypeus. Genae covered dorsally and laterally with stout, black setae. Except for anterolateral corners, frontoclypeus devoid of such setae. Venter of head mostly yellow with dark longitudinal marks below eyes, and surrounding suture connecting right and left genae. Thoracic sclerites dark brown to black and liberally covered with stout black setae. Nota with lateral borders edged in black; pronotum with large rectangular light area laterally. Sclerites of legs golden in color; much lighter than nota or head. Prosternum edged anteriorly in black, with large transverse dark spot posteriorly; rest of sclerite yellow. Poststernal plates dark brown and solid. Labrum dark brown to black; lateral setal fringe straw colored. Abdomen brown; covered with black hairs, and club hairs not located below pleural gills. Dorsal sclerite of anal legs covered with black setae; ventrally anal legs covered with long, slender, brown spine-like setae.

Variation

Symphitopsyche slossonae typically has the centrally located yellow spot; however, there may be some variation to this both within and between populations. First, it is cautioned that the spot may become nearly obscured and overrun by the black pigmentation of the rest of the head. After looking at large numbers of *S. slossonae*, one becomes adept at recognizing such individual variants. Second, there is often variation with the number of spots on the frontoclypeus. The number may vary from one to three. If two or three spots are present, they will always be in a longitudinal row down the center of the frontoclypeus (Fig. 24). Occasionally, these two or three spots may be fused to form one large rectangular spot. We have found northern material to be more variable in this regard than the southeastern material.

Diagnosis

The color pattern of the frontoclypeus of *S. slossonae* is diagnostic for this species. There is no other known *Symphitopsyche* larva that exhibits this type of pattern. *S. slossonae* is easily and quickly recognized by the centrally located yellow spot or spots on the frontoclypeus. Except for the posterior one-fourth of the head, which is usually hidden under the pronotum, the remaining sections are very dark brown to charcoal black. The thoracic sclerites are nearly as dark as the head; the legs are much lighter in coloration.

Material Examined

Minnesota:

Devil's Track R., at Gunflint Trail, Cook Co., Mn., 31-VII-75. D. A. Etnier (several larvae); Stoney R., at Mn. 1, Lake Co., Mn., 16-VIII-75. D. A. Etnier (many larvae); Temperence R., at U.S. 61, Cook Co., Mn., 21-VII-75. D. A. Etnier (3 larvae); Temperence R., at U.S. 61, Cook Co., Mn., 31-VII-75. D. A. Etnier (3 male mmts., 1 larva); Gunflint R., at Gunflint Trail, Cook Co., Mn., 4-VIII-75. D. A. Etnier (6 mmts., several larvae).

North Carolina:

Oconoluftee R., at Smokemont, Great Smoky Mtn. Nat. Pk., Swain Co., N.C., 29-IV-76. G. A. Schuster (many larvae); Oconoluftee R., 2 mi. N. of

Smokemont, Great Smoky Mtn. Nat. Pk., Swain Co., N.C., 1-V-76. G. A. Schuster (many larvae); Shoal Cr., on U.S. 441, 1 mi. S. of Cherokee, Jackson Co., N.C., 1-V-76. G. A. Schuster (1 larva); Oconoluftee R., at Smokemont, Great Smoky Mtn. Nat. Pk., Swain Co., N.C., 21-VI-76. G. A. Schuster (many larvae, several mmts.); Oconoluftee R., at Smokemont, Great Smoky Mtn. Nat. Pk., Swain Co., N.C., 18-VI-76. G. A. Schuster (many larvae, several mmts.); Oconoluftee R., in Cherokee, Swain Co., N.C., 27-VI-76. D. A. Etnier (several larvae).

Tennessee:

West Piney R., Tn. 48, 7 mi. S. of Dickson, Dickson Co., Tn., 2-V-75. G. A. Schuster (several mmts. and larvae); Little R., 2 mi. above Townsend, on Tn. 73, Blount Co., Tn., 14-VII-75. M. Hughes, W. Dickinson, G. A. Schuster (1 male mmt.); Abrams Cr., Great Smoky Mtn. Nat. Pk., Blount Co., Tn., 26-VII-75. C. and G. Schuster (many larvae, several female mmts.); Little Pigeon R., on Co. Rd. 2421, 1 mi. S. of Richardson Cove, Sevier Co., Tn., 11-VI-75. G. A. Schuster (1 larva); Little R., on Tn. 73 at Townsend, Blount Co., Tn., 19-VI-75. M. Hughes, W. Dickinson, G. Schuster (4 larvae); Unnamed stream at Montgomery Bell St. Pk., on U.S. 70, Dickson Co., Tn., 2-V-75. D. A. Etnier, G. A. Schuster (several larvae); W. Prong Little Pigeon R., above Gatlinburg, Sevier Co., Tn., 17-I-76. L. and W. Starnes (several larvae); Chimney's Campground in Great Smoky Mtn. Nat. Pk., Sevier Co., Tn., 3-9-VII-39. A. C. Cole (1 male, 3 females).

Virginia:

Big Stoney Cr., 4 mi. above U.S. 460, Giles Co., Va., 29-V-75. G. A. Schuster (1 male and 1 female mmt. and many larvae).

Distribution

This species is widely spread over the northeastern sections of the U.S. and Canada. It appears to follow the Appalachian Mountains to the southeast, where it is restricted to cold water habitats. Published locale records include: Arkansas, Illinois, Maine, New York, Michigan, Minnesota, New Hampshire, Newfoundland, North Carolina, Pennsylvania, Saskatchewan, Tennessee, and Wisconsin. The additional unpublished record given above is from Virginia.

Biology

Even though this species was described some 70 years ago, little is known of its biology. It is widespread over the northeastern sections of this continent, and even when found further south, it always occurs in cold water situations. This pattern seems to be true for many of the *Symphitopsyche* species which appear to be better adapted to springs and trout-stream-type waters than species of *Hydropsyche*.

It is interesting to note that, in the Great Smoky Mountain National Park, both *S. slossonae* and *S. alhedra* are often collected with *Arctopsyche irrorata* Banks. It is not uncommon to find a medium-to-large-size rock with an *Arctopsyche* larval retreat attached and a larval retreat of either of the above two species directly below it. It would indeed be of interest to further study the relationships between these *Symphitopsyche* species and *A. irrorata*.

Ross (1944) indicates that *S. slossonae* emerges from May to August. Our collection records indicate that this is also true for the southeastern populations.

Symphitopsyche macleodi (Flint)
(Fig. 25)

Symphitopsyche macleodi (Flint), 1965. Proc. Ent. Soc. Wash., 67:169 (Type locality: North Carolina, Blue Ridge Parkway, Crabtree Meadows Campground, 9-VI-61. R. A. and O. S. Flint).

Description

Head capsule length, 1.15 to 1.30 mm; head capsule width, 1.00 to 1.15 mm. Thoracic sclerites and sclerites of legs golden brown. Head capsule except for posterior one-half of frontoclypeus reddish-brown. Posterior one-half of frontoclypeus dark brown, producing the general outline of an arrowhead. Genae, both dorsally and laterally, covered with short, thin, golden setae. Entire frontoclypeus also covered with such setae with the greatest number being concentrated at the posterior one-half of the sclerite. Thoracic sclerites and sclerites of legs covered with short, golden spine-like setae. Labrum dark brown, covered with short, brown setae; laterally margined with long, straw-colored setae. Mesial border of femur covered with patch of black, long setae. Dorsum of abdomen covered with short, black setae and club hairs. Club hairs found below pleural gills in numbers equal to short, black setae. Abdominal gills sparsely branched; branches thick, sausage shaped. Most branching of abdominal gills from apical portion of main stem some branching preapically. Anal leg dorsal sclerite covered with black setae; ventrally covered with thin, golden spine-like setae.

Variation

We have found no distinct variability within populations or between populations of *S. macleodi* that we have examined. Perhaps after this species is better collected and studied, some variations will become apparent.

Diagnosis

This distinct species most closely resembles *S. sparna* with which it may be confused. Both species exhibit golden coloration of the sclerites which is quite atypical of *Symphitopsyche* species. *S. macleodi* may be easily separated from *S. sparna* in a number of ways. First, *S. macleodi* possesses spine-like setae over the entire surface of the frontoclypeus, whereas, on *S. sparna* these are restricted to the anterolateral corners of the frontoclypeus. Second, club hairs are found below the lateral line in *S. macleodi*. These hairs are present only on the dorsum of the abdomen in *S. sparna*. Third, the abdominal gills of *S. macleodi* are not as branched and subdivided as in *S. sparna*. Last, and most easily observed, are the differences in the color pattern of the head. *Symphitopsyche macleodi* is very distinct in having the dark arrowhead-shaped area on the posterior one-half of the frontoclypeus; *S. sparna* never exhibits this. In turn, *S. sparna* commonly possesses three light spots on the frontoclypeus, and when these spots are indistinct, the frontoclypeus is unicolored. This is never the case in *S. macleodi.*

Material Examined

Georgia:

North Fork Chatahootchee R., Tate Br. Campgrd., Rabun Co., Ga., 16-17-V-70. O. S. Flint, Jr. (USNM collection).

North Carolina:

Oconoluftee R., 3.4 mi. W. on Smokemont Rd., Great Smoky Mtn. Nat. Pk., Swain Co., N.C., 12-V-70. O. S. Flint, Jr. (USNM collection); Oconoluftee R., at Smokemont, Great Smoky Mtn. Nat. Pk., Swain Co., N.C., 14-VI-35. H. H. Ross (1 male mmt., Det. G. A. Schuster, 1976).

Tennessee:

George Cox Property, Webb Mtn., Sevier Co., Tn., 17-IV to 17-V-75. G. A. Schuster (many adults); George Cox Property, Webb Mtn., Sevier Co., Tn., 24-I-75. R. Smith, M. Warren, K. Cottrell (many larvae); Horse Cr., Unicoi Management Area, Greene Co., Tn., 9-IV-76. M. Cox, T. Talek, C. Manning, C. Knaught (3 larvae); Spruce Flats Br., Trib. to Middle Prong Little R., Great Smoky Mtn. Nat. Pk., Blount Co., Tn., 16-IV-76. W. C. Dickinson (5 male mmts., 4 larvae).

Virginia:

Grindstone Rec. Area, 4.5 mi. W. of Troutsdale, Smyth Co., Va., 24-V-75. R. Hoffman (USNM collection) (several adults).

Distribution

Records indicate this species may be widely distributed in the southern Appalachians; however, it has not been commonly encountered. Its known range includes the following states: Georgia, North Carolina, Tennessee, and Virginia.

Biology

Little is known about this species. The only published collection records are those given with the description of the species; included above are new records. Field data indicate that this species is adapted to cold water situations. It is most commonly encountered in spring-type habitats but may also be found in trout waters such as the Oconoluftee River of North Carolina. The lack of extensive branching of the abdominal gills may be a further indicator that this species is adapted to cold water saturated with oxygen. This species needs to be collected and studied more extensively before more concrete statements may be made regarding its biology.

Collection records indicate that this species emerges from April through July.

Symphitopsyche sparna (Ross)
(Fig. 26)

Symphitopsyche sparna (Ross), 1938. Ill. Nat. Hist. Surv. Bul., 21:150 (Type locality: Lovells, Michigan, 22-V-36, along Au Sable R. Frison and Ross).

As *Hydropsyche sparna*: Howell, 1939. J. Elisha Mitch. Soc., 55:327; Denning, 1943. Ent. Am., 23:110, 112, 134-136; Ross, 1944. Ill. Nat. Hist. Surv. Bul., 23:88, 96, 97, 294; Leonard and Leonard, 1949. Occ. Pap. Mus. Zoo., Mich., 522:10; Morse and Blickle, 1953. Ent. News, 64:71; Ellis, 1962. Occ. Pap. Mus. Zoo., Mich., 624:8; Etnier, 1965. Ent. News, 76:146; Blickle and Morse, 1966. Me. Ag. Exp. Stat. Tech. Bul., 24:6; Longridge and Hilsenhoff, 1973. Wisc. Acad. Sci., Arts and Letters, 61:176; Resh, 1975. Trans. Ky. Acad. Sci., 36:12.

Description

Head capsule length, 1.20 to 1.30 mm; head capsule width, 1.00 to 1.10 mm. Head, nota and all leg segments golden in color; dorsum of head slightly darker golden brown. Frontoclypeus with a pair of yellow spots anterolaterally, often with an additional single spot in center of the sclerite. These spots often indiscernible and frontoclypeus then appears unicolored. Labrum brown and covered with short, black setae; the lateral brush consisting of long, yellow setae. The genae and nota covered with many short, black setae. Frontoclypeus bears such setae only near geneal sutures and anterolateral corners. Mandibles yellow and edged in brown. Venter of head predominently yellow with some brown patches on stridulatory surface. Prosternum with the posterior border black. Poststernal plates dark brown and solidly sclerotized. Abdomen brownish in color with dorsum covered with short, thin, black hairs and club hairs. Both types of hairs more dense on abdominal segments I - III. Black hairs also found on ventral surfaces of abdomen. Club hairs not found below pleural gills. Ventral surface of anal legs without spine-like setae, adorned with short, black setae.

Diagnosis

This *Symphitopsyche* species is easily identified and separated from other species of the group. *Symphitopsyche sparna*, *S. macleodi*, and *S. ventura* are the only species of this genus which typically have all sclerites golden in coloration. *Symphitopsyche macleodi* and *S. sparna* are readily separated on the basis of head capsule pigmentation. The posterior corner of the frontoclypeus of *S. macleodi* is darkly pigmented forming a dark brown triangle at this portion of the head. *Symphitopsyche sparna* is never pigmented in this manner.

The frontoclypeus of *S. sparna* commonly has three light spots, one located centrally, the other two anterolateral to the first. These spots are often indiscernible, thus, giving the frontoclypeus a unicolored appearance. When this happens, it may be confused with *S. ventura*. These two species may be separated by a number of ways. First, *S. sparna* has many conspicuous, thick, short, black setae on the thoracic nota; on the nota of *S. ventura*, similar setae are not as numerous nor are they as thick and conspicuous as in *S. sparna*. Second, the club hairs on the abdomen of *S. ventura* are much more numerous and conspicuously thicker than those of *S. sparna*. Also, numerous club hairs are found below the pleural gills in *S. ventura*, while in *S. sparna* this is not the case. Last, the head of *S. sparna*, except for the typical three light spots on the frontoclypeus, is unicolored; whereas, the dorsal surface of the head of *S. ventura* is much darker than the lateral surfaces, and the frontoclypeus is unicolored. *Symphitopsyche sparna* is very widely distributed and is commonly collected in all types of habitats, while *S. ventura* has only been collected and reported a few times since its description.

Material Examined

Alabama:

Mossy Springs Cr., at Edward Parson's Farm, Limestone Co., Al., 22-V-76. G. A. Schuster (many larvae); Tributary to Talapoosa R., 2 mi. S. of Woodland on Al. 48, Randolf Co., Al., 28-V-76. D. A. Etnier, G. A. Schuster (2 male mmts., several larvae).

Kentucky:

Silver Cr., on Ky. 876, 5 mi. W. of Richmond, Madison Co., Ky., 13-VI-76. G. A. Schuster (several mmts. and larvae).

Minnesota:

North Branch Sunrise R., Chisago Co., Mn., 21-VII-75. D. A. Etnier (3 male mmts., several larvae); Cascade R., at &. S. 61, Cook Co., Mn., 13-VIII-75. D. A. Etnier (1 male mmt., 7 larvae); Gunflint R., at Gunflint Trail, Cook Co., Mn., 4-VIII-75. D. A. Etnier (many larvae).

North Carolina:

Saluda R., at Valhalla, Haywood Co., N.C., 24-V-75. D. A. Etnier, G. A. Schuster (1 male mmt., 1 larva); Shoal Cr., on U.S. 441, 1 mi. S. of Cherokee, Jackson Co., N.C., 1-V-76. G. A. Schuster (several mmts., many larvae); Pumpkin Town Cr., on U.S. 441, Jackson Co., N.C., 1-V-76. G. A. Schuster (several larvae, 1 male mmt.); Oconoluftee R., at Smokemont, Great Smoky Mtn. Nat. Pk., Swain Co., N.C., 1-V-76. G. A. Schuster (8 larvae); Cullasaja R., 11.9 mi. above jct. N.C. 28 and U.S. 441 and 23, near Franklin, Macon Co., N.C., 9-V-76. D. A. Etnier (4 larvae); Cullasaja R., 6 mi. W. of Highlands, Macon Co., N.C., 19-VI-76. G. A. Schuster (many larvae); Oconoluftee R., at Smokemont, Great Smoky Mtn. Nat. Pk., Swain Co., N.C., 27-VI-76. D. A. Etnier (several larvae, 1 male mmt.).

South Carolina:

Lynches R., at Lanchester-Chesterfield Co. line, on S.C. 9, S.C., 26-V-75. D. A. Etnier, G. A. Schuster (1 male mmt., 1 larva).

Tennessee:

Walker Br. Trib. to Tellico R., on Tn. 210, Monroe Co., Tn., 20-VI-74. D. A. Etnier, G. A. Schuster (1 male mmt.); Little Pigeon R., Maple Br. Rd., off Tn. 2421, near Richardson Cove, Sevier Co., Tn., 10-VII-74. C. A. Schuster, G. A. Schuster (1 male mmt., 4 larvae); George Cox Property, Webb Mtn., Sevier Co., Tn., 17-IV to 17-V-75. G. A. Schuster (many adults); Little R., at U.S. 411, Blount Co., Tn., 23-IV-75. C. A. Schuster and G. A. Schuster (1 male mmt.); Conasauga R., at Tn. 74, Bradley Co., Tn., 4-V-75. D. A. Etnier and G. A. Schuster (1 male mmt.); Hurricane Cr., 2 mi. N. of Tn. 62, Fentress Co., Tn., 1-V-75. D. A. Etnier, G. A. Schuster (2 male mmts.); Little R., 2 mi. above Townsend, Blount Co., Tn., on Tn. 73, 14-VII-75. M. Hughes, W. Dickinson, G. Schuster (several larvae); Abrams Cr., Great Smoky Mtn. Nat. Pk., Blount Co., Tn., 26-VII-75. C. A. and G. A. Schuster (1 male mmt., several larvae); Stream at Montgomery Bell St. Pk. Entrance on U.S. 70, Dickson Co., Tn., 2-V-75. D. A. Etnier, G. A. Schuster (1 male mmt.); Little Pigeon R., 1 mi. S. of Richardson Cove, on Co. Road 2421, Sevier Co., Tn., 21-VI-75. G. A. Schuster (many larvae); Little R., in Townsend, Blount Co., Tn., 19-VI-75. M. Hughes, W. Dickinson, G. A. Schuster (15 larvae); Obed R., at Genesis Rd., Cumberland Co., Tn., 26-V-75. D. A. Etnier (1 male and 1 female mmt., 1 larva); Caney Fork R., 1.3 mi. E. of Pleasant Hill, Cumberland Co., Tn., 14-IV-76. G. A. Schuster (1 male mmt.).

Wisconsin:

Lowes Cr., 1 mi. W. of State St., Eau Claire, Eau Claire Co., Wi., 28-VIII-75. D. A. Etnier (3 male mmts.).

Distribution

Symphitopsyche sparna is widely distributed in eastern North America. Published records include the following states and provinces: Georgia, Kentucky, Maine, New York, Michigan, Minnesota, North Carolina, Nova Scotia, Ontario, South Carolina, Tennessee, Virginia, West Virginia, and Wisconsin. Unpublished records included here are from Alabama.

Biology

This species has been collected widely over the southeastern United States. In this part of the country, *S. sparna* seems to be ubiquitous. It has been taken in a variety of habitats ranging from first order streams to large river situations. In this respect *S. sparna* seems to have the widest range of tolerance to environmental conditions of any *Symphitopsyche* species collected by the authors. It is commonly collected in small, sluggish, organically rich streams as well as fast, clean, cold trout-stream-type waters.

Its northern range, however, is more puzzling. It has a rather spotty distribution often commonly encountered and just as often absent altogether. A good example of this situation occurs in Illinois, a state which has been extensively collected (Ross, 1944) and one which is almost devoid of this species (Unzicker, personal communication).

Collection records indicate this species emerges from April to September and is probably univoltine.

Symphitopsyche ventura (Ross)
(Fig. 27)

Symphitopsyche ventura (Ross), 1941. Trans. Am. Ent. Soc., 67:92 (Type locality: Costellow Lake, Algonquin Pk., Ont. Fish. Res. Board, 10-VI-39. W. M. Sprules).

As *Hydropsyche ventura*: Ross, 1944. Ill. Nat. Hist. Suv. Bul., 23:294; Blickle and Morse, 1966. Me. Ag. Exp. Stat. Tech. Bul., 24:6; Etnier, 1973. J. Ga. Ent. Soc., 8:273.

Description

Head capsule length, 1.20 to 1.28 mm; width, 0.99 to 1.10 mm. Posterior one-fifth of dorsal surface of head yellow; rest of head dark brown. Lateral aspects of head yellow; venter of head yellow with brown pigmentation on stridulatory surface and geneal suture. Genae covered with short, brown setae dorsolaterally. Frontoclypeus with such setae scattered over sclerite. Labrum dark brown covered with short, black setae; laterally margined with long, yellow setae. Mandibles dark brown and edged in black. Thoracic sclerites golden to dark brown; covered with thin, short, brown hairs. Each notum also covered with short, golden spine-like setae which are not very conspicuous. Abdomen straw colored and covered dorsally and ventrally with short, black hairs. Each abdominal segment with numerous club hairs which are also found below the pleural gills. Dorsal sclerite of anal legs covered with short, black hairs. Venter of anal legs also covered with such hairs.

Diagnosis

This species may be separated on the basis of the frontoclypeus color pattern. The frontoclypeus is unicolored dark brown rather than black. It may be confused with the inconspicuously spotted *S. sparna*. However, a number of characters may be utilized to separate these two species. First, the abdominal gills of *S. ventura* are not as profusely branched as in *S. sparna*. Second, *S. sparna* has many conspicuous, thick short, black setae on the thoracic nota; on the nota of *S. ventura* similar setae are not as numerous nor are they as thick and conspicuous. Third, the club hairs on the abdomen of *S. ventura* are much more numerous and conspicuously thicker than those of *S. sparna*. Also, numerous club hairs are found below the pleural gills in *S. ventura* but not in *S. sparna*. Fourth, the head of *S. sparna*, except for the typical three light spots on the frontoclypeus, is unicolored; whereas, the dorsal surface of the head of *S. ventura* is much darker than the lateral surfaces the the frontoclypeus is unicolored.

Material Examined

Newfoundland:

Big Falls, Newfoundland, 28-VI-66. D. R. Smith (adult males; USNM) collection).

New York:

Bear Brook near Blue Mtn. Lake, Adirondack St. Pk., N.Y., 19-VI-41. Frison and Ross (adults; INHS collection); Cedar R. near Indian Lake, Adirondack St. Pk., N.Y., 20-VI-41. Frison and Ross (adults; INHS collection).

Tennessee:

English Cr., at Carson's Springs near Newport, Cocke Co., Tn., 3-8-VI-46. Mike Wright (adults; INHS collection); Lost Cr., on waterfalls on Co. Rd. 4448, 6 mi. S.E. of Sparta, White Co., Tn., 14-IV-76. G. A. Schuster (2 males and 6 female mmts.); Anderson Cr., trib. to New R., 1.3 mi. S.S.W. of Montgomery Jct., W. of Co. Rd. 2344, Scott Co., Tn., 1-VII-76. T. Talak (1 male mmt.); Jake Branch, at Tn. 63, on Scott/ Campbell Co. line, 2-VII-76. T. Talak (1 male mmt., 2 larvae).

Virginia:

Gilletts Run, 10 mi. N. of Warm Springs, Bath Co., Va., 17-VII-71. A. B. Gurney (adult males; USNM collection).

Distribution

Little is known of the distribution of this rarely collected species. scattered collections have been reported from the following regions: Newfoundland, New York, Ontario, Tennessee, and Virginia.

Biology

The largest collection of metamorphotypes is from Lost Creek in White County, Tennessee. At this locality Lost Creek is a 60 degree to 90 degree waterfall with moderate to fast currents. The depth averages less than 6 inches and the width is approximately 30 feet. The shore vegetation is mixed deciduous which produces cover. The bottom consists primarily of bedrock with some loose rocks of medium size near the upper portions of the falls. The substrate is lushly covered with moss. No larvae were collected here; however, the pupae were found attached to the moss growing in the fastest water. Since most of the substrate was bedrock, collections had to be made by feeling for pupal cases or larval retreats. This may be the reason no larvae were collected since it is very difficult to obtain access into the small cracks and crevices of the bedrock in which the larval retreats are often located.

Other larval caddisflies collected at Lost Creek included: *Micrasema* sp., *Goerita betteni*, *Diplectrona modesta*, *Oropsyche* sp., *Hydropsyche* sp. (*depravata* group).

According to available collection records, *S. ventura* emerges from early April through September.

Symphitopsyche piatrix (Ross)
(Presumed Larva, Fig. 28)

Symphitopsyche piatrix (Ross), 1938. Ill. Nat. Hist. Surv. Bul. (Type locality: Greer, Missouri, 28-III-37, at spring near town. T. H. Frison).

As *Hydropsyche piatrix*: Ross, 1944. Ill. Nat. Hist. Surv. Bul., 23:88, 96, 97, 294; Corbet et al., 1966. Can. Etn., 98:1290; Unzicker et al., 1970. J. Ga. Ent. Soc., 5:171.

These larvae have not been definitely associated with the adult form. On the basis of having been collected near the type locality of *S. piatrix* and because all other *Symphitopsyche* larvae collected in the area can be recognized, it is presumed that these larvae are actually *S. piatrix*.

Description

Head capsule length, 1.25 to 1.30 mm; width, 1.05 to 1.10 mm. Head predominantly golden with some dark brown pigmentation. Frontoclypeus with four rectangular brown bars arranged in center of sclerite. One bar anterior, and one posterior to two lateral bars. This arrangement produces a yellow spot located centrally. Head capsule also with dark brown transverse stripe across the width of the head at posterior insertion of frontoclypeus. Genae covered dorsally and laterally with small, clear setae; located anterior to transverse brown stripe. No pigmentation around eye or on venter of head. Labrum golden, covered with similarly colored setae dorsally; laterally with long fringe of yellow setae. Nota light brown to straw colored; each covered with very small, clear setae. All leg segments light brown to straw colored and liberally covered with small, clear setae. Prosternum golden with black markings posteriorly; poststernal plates solid and golden in color. Abdomen golden brown, covered with short, black setae. Club hairs, if present, inconspicuous. Dorsal sclerite of anal legs covered with very thin, golden setae. Ventral surface of anal legs with large heavily sclerotized spine-like setae, especially concentrated anteriorly. These setae at least as heavy as those on ventral sclerites of abdominal segment IX.

Diagnosis

The larvae available for study for all characteristically light colored, much like *S. sparna* and *S. macleodi*. However, it is easily separated from these two species on the basis of head color pattern (Fig. 28) as described above. Furthermore, this larva can be separated from all other *Symphitopsyche* species by the following characters: (1) Few or no club hairs are present on the dorsum of the abdomen; if they are present, they are inconspicuous. (2) Heavy spines are located on the ventral surface of the anal legs. These spines are at least as large and as heavily sclerotized as those on the ventral sclerites of the ninth segment. No other *Symphitopsyche* species possesses such large and conspicuous spines on the anal legs.

Material Examined

Arkansas:

Down stream from Mammoth Spring, 40 yards N. of jct. with Spring R., in Mammoth Spring, Fulton Co., Ar., 25-IX-76. H. W. Robison (14 larvae).

Missouri:

Head waters of Current R., 15 mi. S.E. of Licking in Montauk St. Park, Dent Co., Mo., 1-IV-67. G. L. Harp (3 larvae); Seven Springs, head water of Current R., Montauk St. Park, Dent Co., Mo., 2-IV-67. G. L. Harp (9 larvae).

Distribution

Symphitopsyche piatrix is apparently restricted to spring-type habitats in the Ozark Mountains of southern Missouri and Arkansas. Only one record, that of Corbet et al. (1966), lists the species from other than this vicinity. They record it from the St. Lawrence River in Quebec, but we are inclined to believe it is a misidentification of *S. walkeri*, a closely related species.

Biology

Other than to say that *S. piatrix* is restricted to spring-like environments, we cannot add more concerning its biology. It was described in 1938 by Dr. Ross and has been reported on only three other occasions, one of which is probably in error. The rarity of this species in collections and reference to it in the literature cannot be considered an indication of the abundance of this species. It is more likely that this rarity is a product of limited sampling by Trichopterologists in its geographical range. Hopefully, in the future, this species will be studied in greater detail.

Symphitopsyche etnieri (Schuster and Talak)
(Fig. 29)

Symphitopsyche etnieri (Schuster and Talak), 1977. J. Kan. Ent. Soc. (Type locality: Buffalo Springs Cr., Buffalo Springs, Grainger Co., Tn.).

Description

Head capsule length, 1.40 to 1.50 mm; width 1.25 to 1.35 mm. Head dark brown excepting yellow area around eyes and large yellow spot on the posterior lateral aspects of the genae. Posterior dorsal portion of genae slightly lighter than rest of head with numerous dark brown circular muscle scars. Anterior one-third of frontoclypeus darker (almost black) than rest of sclerite. Short, brown setae present on dorsolateral aspects of genae. Scattered setae located at anterolateral corners and posterior angle of frontoclypeus. Labrum very dark brown, covered with black setae; laterally margined with long, yellow setae. Mandibles dark brown, edged in black. Thoracic nota dark brown; pronotum slightly darker than other two nota. Each nota covered with thin, short, black setae, and laterally edged in black. Mesonotum with wide, U-shaped mark posteriorly; metanotum with short, black slash mark posteriorly. Prosternum brown with anterior and posterior margins black. Poststernal plates brown. Anterior legs brown; mes and metathoracic legs golden. Each leg segment amply covered with short, brown spine-like setae not unlike those of other species. Abdomen tan covered with moderate number of thin, short, black hairs. Club hairs on dorsum and below pleural gills only slightly thicker than other hairs. Dorsal sclerite of anal legs covered with short black hairs as are the ventral surfaces.

Variation

No variation from the above description was found in the larvae studied.

Diagnosis

This species may be separated from most other *Symphitopsyche* species on the basis of head capsule coloration. Only one other species, *S. alhedra*, has similar pigmentation. These two species may be reliably separated by: (1) the presence of numerous circular dark brown muscle scars (Fig. 29) on the dorsal posterior mesial portion of the head in *S. etnieri* which are absent in *S. alhedra*; (2) the abdomen of *S. etnieri* has considerably fewer hairs especially on the ventral surfaces, and the hairs are thinner and not as long as those of *S. alhedra*; (3) the club hairs are more slender and less conspicuous in *S. etnieri*; (4) in general, *S. etnieri* is less robust and smaller than *S. alhedra*. The pigmentation of *S. etnieri* is not as dark as that of *S. alhedra*; also, the sclerites, especially those of the head, are not as shiny.

Material Examined

Tennessee:

Buffalo Springs Cr., 100 yds. W. of jct. Co. Rds. 2479 and 2480, Buffalo Springs, Grainger Co., Tn., 13-IX-76. T. Talak (23 male and 17 female mmts., 60 larvae); Buffalo Springs Cr., 100 yds. W. of jct. Co. Rds. 2479 and 2480, Buffalo Springs, Grainger Co., Tn., 18-IX-76. T. Talak (5 adult males, 20 adult females).

Distribution

The only distribution records for this species are those given above. These are from the type locality, Buffalo Springs Creek, in the community of Buffalo Springs, Grainger County, Tennessee. The stream is 100 meters west of the junction of county roads 2479 and 2480. This is approximately 3.3 miles southeast of the junction of county road 2480 and U.S. 11W. Buffalo Springs is approximately 4.0 air miles southwest of Rutledge, Tennessee, which is the county seat.

Biology

Knowledge regarding the biology and emergence times of this species is scant since it has been collected on only two occasions. However, the following can be stated regarding the type locality which may be indicative of the preferred habitat of this species.

Buffalo Springs Creek begins as a spring approximately 1,000 meters upstream from the type locality. Below this, much of the spring is diverted into a trout hatchery from which the effluent is returned to the stream. The effluent has a high concentration of organic wastes. Due to the origin of the stream and the presence of the trout hatchery, the water temperature is fairly constant throughout the year. *Symphitopsyche etnieri* was the only *Symphitopsyche* species present, and *Cheumatopsyche campyla* Ross was the only other caddisfly collected at this site.

Existing in a cold-water, spring-type habitat is not unique to this species of *Symphitopsyche*. Many species of the genus seem to exhibit an adaption to cold water situations. For example, species such as *S. piatrix* Ross and *S. macleodi* Flint have been collected only in these types of environments.

The Genus *Hydropsyche*

Depravata Species Group

Hydropsyche betteni Ross
(Fig. 1 and 30)

Hydropsyche betteni Ross, 1938. Ill. Nat. Hist. Surv. Bul. 21:146-147 (Type locality: Richard, Ill., 28-V-36. Ross).

Hydropsyche betteni: Betten, 1934. Caddis Flies N.Y. St., p. 188 (as *incommoda*, not Hagen); Ross, 1941a. Tr. Amer. Ent. Soc., 67:85; Denning, 1943. Ent. Amer., 23:103-105; Ross, 1944. Ill. Nat. Hist. Suv. Bul., 23:86, 91, 93, 99-100, 294; Leonard and Leonard, 1949. Occ. Pap. Mus. Zoo., Mich., 522:9; Etnier, 1965. Ent. News, 76:146; Blickle and Morse, 1966. Me. Ag. Exp. Sta. Tech. Bul., 24:6; Edwards, 1966. J. Tenn. Acad. Sci., 49:120; Unzicker et al., 1970. J. Ga. Ent. Soc., 5:171; Longridge and Hilsenhoff, 1973. Wisc. Acad. Sci., Arts and Letters, 61:176; Resh, 1975. Trans. Ky. Acad. Sci., 36:12.

Description

Head capsule length, 1.40 to 1.50 mm; head capsule width, 1.25 to 1.40 mm. Entire head very dark brown to black except for yellow area around eye; occasionally with pair of inconspicuous pale spots on anterior portion of frontoclypeus. Numerous bristle-like, black setae on top and sides of genae; similar setae on anterolateral corners and across front margin of frontoclypeus. Area at posterior angle of frontoclypeus slopes downward. Labrum dark brown to black with numerous black setae; laterally fringed with long, yellow setal brush. Mandibles dark brown to black. Nota dark brown, laterally margined in black, each notum with many bristle-like setae. All legs dark brown, abundantly adorned with black setae and gold spine-like setae. Prosternum bronze, anteriorly and posteriorly edged in black. Prosternal and mesosternal plates dark brown fairly well sclerotized. Abdomen brown; covered with numerous scale hairs; equally abundant on all abdominal segments. Minute spines present on dorsum of all abdominal segments. Anal legs lacking large, heavily sclerotized spine-like setae, but with minute spines present on venter of last two abdominal segments.

Variation

Hydropsyche betteni larvae are typically black-headed with no light markings except those around the eyes. However, some populations do have individuals which may exhibit a pair of medium-sized spots on the frontoclypeus. These spots are only slightly lighter than background color and are rather inconspicuous. This condition is rather atypical, but one population found consists primarily of such individuals. This population occurs below Lake Toxaway Dam on U.S. 64 in Transylvania County, North Carolina.

Diagnosis

The larvae of this species most closely resemble those of *H. depravata* and *H. potomacensis*, to which it is closely related. At this time no reliable characters have been discovered to separate these three species. *Hydropsyche betteni* may at times, however, be separated from the other two species on the basis of its range, since the ranges of *H. depravata* and *H. potomacensis* are much more restricted.

Material Examined

Kentucky:

Silver Cr., on Ky. 876, 5.0 mi. W. of Richmond, Madison Co., Ky., 7-VII-76. C. A. and G. A. Schuster (2 male mmts., several larvae); Silver Cr., on Ky. 876, 5.0 mi. W. of Richmond, Madison Co., Ky., 13-VI-76. G. A. Schuster (several larvae).

North Carolina:

Panther Cr., at Fines Cr. exit on I-40, Haywood Co., N.C., 24-V-75. G. A. Schuster, D. A. Etnier (2 male mmts.); Shoal Cr., on U.S. 441, 1.0 mi. S. of Cherokee, Jackson Co., N.C., 1-V-76. G. A. Schuster (2 male mmts., 4 larvae); Cullasaja R., 6.0 mi. W. of Highlands, Macon Co., N.C., 19-VI-76. G. A. Schuster (several larvae); Cullasaja R., just below dam at Highlands, Macon Co., N.C., 27-VI-76. D. A. Etnier (several pupae and larvae); Below Toxaway Dam, 10 mi. E. of Cashiers, Transylvania Co., N.C., on U.S. 64, 2-VIII-76. C. A. and G. A. Schuster (many mmts. and larvae).

Tennessee:

Unnamed Cr., 1.0 mi. from Johnson Bible College, Knox Co., Tn., 12-IV-75. D. and L. Etnier, G. A. Schuster (2 male mmts.); Turkey Cr., Loudon Co., Tn., 11-IV-75. D. A. Etnier (1 male mmt.); Flat Cr., Morgan Co., Tn., 26-IV-75. D. A. Etnier (several mmts. and larvae); Gap Cr., off Co. Rd. 2586, 2.0 mi. S. of Johnson Bible College, Knox-Sevier Co. line, 16-IV-75. G. A. Schuster (1 male mmt.); Hurricane Cr., 2.0 mi. N. of Tn. 62, Fentress Co., Tn., 1-V-75. D. A. Etnier, G. A. Schuster (3 male mmts.); Caney Fork R., on unnamed Co. Rd., 2.0 mi. N.E. of Pleasant Hill, Cumberland Co., Tn., 23-VII-75. G. A. Schuster (1 male mmt.); Little Emory R., near Wartburg, Morgan Co., Tn., 26-IV-75. D. A. Etnier (1 adult male, 1 male mmt., several larvae); Clear Cr., at Fentress and Cumberland Co. line on Tn. 62, 1-V-75. D. A. Etnier, G. A. Schuster (1 male mmt., several larvae); Bull Run Cr., on Tn. 162 just S. of Oak Ridge, Knox Co., Tn., 8-IV-76. D. A. Etnier, G. A. Schuster (1 male mmt., 3 larvae); Unnamed Cr., at University of Tennessee Arboretum, Oak Ridge, Morgan Co., Tn., 6-IV-76. D. A. Etnier (several male mmts. and larvae).

Virginia:

Small Trib. to James R., 0.4 mi. E. of Va. 615 on Va. 621, Powhattan Co., Va., 13-VI-75. D. A. Etnier, W. C. Starnes (several mmts. and larvae).

Distribution

This species has been recorded from the following states and provinces: Arkansas, Georgia, Illinois, Indiana, Kentucky, Maine, Michigan, Minnesota, New Hampshire, Ohio, Ontario, Pennsylvania, Tennessee and Wisconsin. With the additional new records from North Carolina and Virginia as listed above.

Biology

As stated above, this species is very common in small, warm-water streams. It is often found in very large numbers, much like *H. orris* in large rivers. *H. betteni* seems to be one of the most resistant *Hydropsyche* species to organic pollution. Its ability to cope with and use the high concentrations of organic materials may contribute to the high numbers of individuals in the populations collected. It has been found that, where *H. betteni* occurs, it is usually the most predominant caddisfly present. It is often the only *Hydropsyche* species in the stream, but it is not uncommon for other species to occur with *H. betteni*. The species most often collected with *H. betteni* is *Symphitopsyche sparna* which also seems to be resistant to high concentrations of suspended materials.

The emergence period of *H. betteni* is from April to September.

Hydropsyche depravata Hagen

Hydropsyche depravata Hagen, 1861. Syn. Neur. N. Am., p. 290 (Type locality: "Dalton, Ga. (Osten Sacken)").

Hydropsyche depravata: Hagen, 1864. Verh. Zoll. Bot. Ges., 14:822; Banks, 1892. Tr. Amer. Ent. Soc., 19:367; Ulmer, 1905. Z. Insbiol., 1:68; Ulmer, 1907. Gen. Ins., 60:71; Banks, 1907. Cat. Neur. Ins. U.S., p. 47; Betten, 1934. Caddis Flies N.Y. St., p. 187-188; Milne, 1936. Stud. N. Am. Trich., 3:70, 72, 73; Banks, 1936. Psyche, 43:129; Ross, 1938c. Psyche, 45:17; Brimley, 1938. Ins. N. Carolina, p. 251; Ross, 1944. Ill. Nat. Hist. Surv. Bul., 23:15, 91, 93, 100, 294; Edwards, 1966. J. Tenn. Acad. Sci., 41:120; Resh, 1975. Trans. Ky. Acad. Sci., 36:12.

Variation

The larvae of this species are generally dark-headed like *H. betteni* with light areas only around the eyes. However, one population has been collected from the Stones River near Nashville, Tennessee, which is much lighter in color. The head capsule of these specimens is rich brown rather than black with lighter areas behind the eyes.

Diagnosis

Hydropsyche depravata larvae and metamorphotypes have been collected from a number of different localities; however, to date this species cannot be separated from larvae of *H. betteni* and *H. potomacensis* (see Fig. 30). No reliable characters have been found to consistently differentiate the above three species from one another.

Material Examined

Tennessee:

Bennett Cr., on Bennett Cr. Rd., at Bennett Cr. Baptist Church, Knox Co., Tn., 16-IV-75. G. A. Schuster (1 male mmts., numerous larvae); Stock Cr., off Tipton Station Rd., off U.S. 441, Knox Co., Tn., 16-IV-75. G. A. Schuster (2 male mmts., several larvae); Turkey Cr., off Northshore Dr., Knoxville, Knox Co., Tn., 17-IV-75. D. A. Etnier (1 male mmt.); Small Cr., 1.0 mi. S. of Johnson Bible College, Knoxville, Knox Co., Tn., 12-IV-75. D. A. and L. Etnier, G. A. Schuster (1 male mmt., several larvae), Caney Fork R., 2.0 mi. N.E. of Pleasant Hill on unnamed Co. Rd., Cumberland Co., Tn., 14-IV-76. G. A. Schuster (many larvae, several mmts.).

Georgia:

Below dam on spring at jct. Ga. 2 and Ga. 223, Murray Co., Ga., 25-IV-76. G. A. Schuster, D. A. Etnier, J. Williams (3 male mmts., many larave).

Distribution

Hydropsyche depravata is known from the following states: Indiana, Kentucky, North Carolina, and Tennessee. The above collection locale from northern Georgia represents a new distribution record. Its range is much more restricted than that of *H. betteni*.

Biology

This species, like *H. betteni*, lives typically in small, warm-water streams which have high amounts of organic material. The larvae are found in the riffle areas of these streams on medium-sized rocks. As with *H. betteni*, when *H. depravata* is present, it occurs in large numbers. On occasion, *H. depravata* and *H. betteni* metamorphotypes have been collected in the same stream at the same time; however, the two larvae are indistinguishable from one another.

Hydropsyche potomacensis Flint

Hydropsyche potomacensis Flint, 1965. Proc. Ent. Soc. Wash., 67:169-171 (Type locality: Virginia, Highland Co., bridge on Rt. 220 over E. Fk. Potomac R., 18-20-V-63. W. D. Field and O. S. Flint, Jr.).

Diagnosis

Hydropsyche potomacensis has been associated, but no reliable characters have been found to separate it from the larvae of *H. betteni* and *H. depravata* (Fig. 30).

Material Examined

Virginia:

North R., at the bridge at jct. of Va. 11 and Va. 727, out of Mt. Crawford, Rockingham, Co., Va., 17-VIII-75. G. W. Wolfe (2 male mmts., 10 larvae).

Distribution

This species was previously known only from the type material which was collected from the East Fork of the Potomac River.

Biology

Because this species has been collected only twice, very little is known of its biology. The river in which the larvae were collected is a medium, warm-water river similar to the type of habitat in which *H. depravata* and *H. betteni* have been commonly collected.

Based on the type material and the pupal collections, it is surmised that the emergence period is at least May through August and, in all probability, may be longer than this.

Hydropsyche elissoma Ross
(Fig. 31A and B)

Hydropsyche elissoma Ross, 1947a. Trans. Am. Ent. Soc., 73:137-138 (Type locality: Mossy Cr., Perry, Ga.), 31-III-45. P. W. Fattig).

Description

Head capsule length, 1.10 to 1.20 mm; head capsule width, 1.05 to 1.15 mm. Head on top mostly dark brown; frontoclypeus with a pair of large, diagonal, tear-shaped yellow marks. Area around epicranial stem yellow; brown blotch laterally to this consisting of several darker oval muscle scars. Similar smaller, dark blotches of muscle scars lateral to these. Area around eye and behind it yellow reaching dorsally posteriad to form rough, L-shaped, light area. Venter of head bronze, not as dark as top of head, with few scattered, slightly darker muscle scars. Head from lateral view distinctly deeper posteriorly than anteriorly. In dorsal view head wider anteriorly, sides of head with slight constriction centrally. Frontoclypeus at posterior angle distinctly thickened into large, low and rounded tubercle, best observed in lateral view. Top and sides of genae with numerous bristle-like, black setae; present on the frontoclypeus only on the anterolateral corners. Labrum brown; adorned with black and yellow setae; laterally fringed with long, yellow, setae. Mandibles golden with black margins; pronotum slightly darker than other two nota. Pronotum and mesonotum with numerous stout, bristle-like setae each in a brown pocket giving nota freckled appearance; metanotum with very few of these. Prosternum clear yellow with black posterior margin; prosternal and mesosternal plates clear yellow, not heavily sclerotized. Legs yellow, anterior pair slightly darker than others. All legs adorned with numerous spine-like and bristle-like setae. Abdomen brown with numerous scale hairs posteriorly decreasing in number and size anteriorly. Minute abdominal spines on dorsum of all segments decreasing in size and number posteriorly. Venter of anal legs without large, sclerotized spine-like setae, but with minute spines that are on venter of both segments VIII - IX as well.

Diagnosis

This species can be most easily distinguished from others on the basis of the large, rounded tubercle (Fig. 31B) on the posterior angle of the frontoclypeus. The color pattern is very similar to that of *H. decalda* which also has two large tear-shaped marks on the frontoclypeus. But in the case of all other species, *H. decalda* lacks the posterior frontoclypeal tubercle.

Material Examined

Georgia:

Beaver Cr., 1.0 mi. S. of Roberta, Crawford Co., Ga., 5-IX-76. G. A. Schuster (1 male mmt., 10 larvae).

Distribution

This species was previously known only from the type material described by Ross (1947a). The larval material examined was collected approximately 20 miles from this locality.

Biology

Hydropsyche elissoma is one of the least known *Hydropsyche* species. The stream from which the above larvae were collected was approximately 1.2 meters wide and 0.6 meters deep and approached a black-water condition. The bottom was dominantly sand with some medium-sized rocks in a short riffle area. No larvae were collected in the riffle on rocks; all were collected in submerged branches and logs into which they bored larval retreats. The larvae themselves were in canals in the wood, and around each hole was a rather short net. The larvae were collected by dismantling the wood; the pupa was found in the wood itself. The pupal case was distinctly pliable and consisted of mostly of secreted material with some wood fibers incorporated. Collected with *H. elissoma* were several *H. decalda* larvae.

Little can be said of the emergence period of *H. elissoma* since it has been collected so infrequently. The type material was collected in March which suggests that this species emerges at least from March until September.

Hydropsyche decalda Ross
(Fig. 32)

Hydropsyche decalada Ross, 1947a. Trans. Am. Ent. Soc., 73:138-139 (Type locality: Beaver Cr., 5 mi. S.E. of Roberta, Ga., 6-IX-45. P. W. Fattig).

Description

Head capsule length, 1.30 to 1.45 mm; head capsule width, 1.25 to 1.40 mm.

Head predominantly straw-colored with large areas of brown and numerous small, oval, dark brown to black muscle scars. The frontoclypeus brown with pair of large, tear-shaped, yellow spots anterolaterally. Frontoclypeus with numerous small dark brown to black pits. Genae mostly straw-colored with numerous dark brown, oval muscle scars dorsally and laterally; venter of genae slightly darker and also with muscle scars especially posteriorly. Genae with short, bristle-like, black setae on top and sides, interspersed with many clear, short, spine-like setae. Posterior half of frontoclypeus with many thin, short, clear setae. Head from lateral view distinctly sloping; deeper posteriorly. In dorsal view, head wider anteriorly. Sides of anterior half of head bulging outward. Nota same color as head and laterally margined in black. Pronotum and mesonotum with numerous bristle-like, black setae and short, clear spine-like setae in dark brown pits giving sclerites freckled appearance. Each notum with several larger, dark brown, round muscle scars on lateral aspects of sclerites; pronotum with about twice as many as other nota. Prosternum yellow with black posterior margin; prosternal and mesosternal plates yellow and weakly sclerotized. Legs yellow; anterior pair slightly darker; all legs covered with many spine-like setae and long, black setae. Abdomen brown; covered with numerous scale hairs posteriorly; decreasing in sized and number anteriorly. Minute spines on dorsum of all abdominal segments VIII - IX. Anal legs lacking large, heavily sclerotized spine-like setae on ventral surfaces.

Diagnosis

This species is closely related to *H. elissoma* and resembles most closely that species. These two species differ from other species in the *depravata* group in that they lack a coal-black head and nota. *H. decalda* can be recognized by the color pattern of the head, especially the two, large, tear-shaped, diagonal marks on the frontoclypeus, the small, brown pits on the frontoclypeus, and the numerous brown, oval muscle scars on the top, side, and bottom of the genae. This color pattern is not too unlike that of *H. elissoma* except that *H. elissoma* has a much darker frontoclypeus and not as many muscle scars on the genae. The single most distinguishing character between these two species is the lack of the posterior frontoclypeal tubercle in *H. decalda*. It can be readily observed in lateral aspect in *H. elissoma*.

Material Examined

Georgia:

Beaver Cr., 1.0 mi. S. of Roberta, Crawford Co., Ga., 15-IX-76. G. A. Schuster (3 larvae).

Louisiana:

Little Bayou Pierre, Natchitoches Par., La., 29-XII-73. J. A. Louton (6 larvae); Little Bayou Pierre, Natchitoches Par., La., 17-III-74. J. A. Louton (11 larvae); Little Bayou Pierre, Natchitoches Par., La., 5-IV-74. J. A. Louton (3 larvae); Little Bayou Pierre, Natchitoches Par., La., 22-V-77. D. A. Etnier, U. T. Regional Faunas Class (several larvae, 3 male meto.);

Texas:

Big Cow Cr. at Hwy. 63, Newton Co., Tx., 22-V-77. D. A. Etnier, U. T. Regional Faunas Class (several larvae, 1 male mmt.).

Distribution

Previously this species was known only from the type locality from which three *H. decalda* larvae were collected. The above records from Little Bayou Pierre, from which adults have been taken as well, and Texas constitute a significant range extension of this species. If more work were to be done in the south, it may be found that this species is fairly widespread. Its rarity in collections may well be due to lack of strenuous light-trap collecting in the south rather than it being naturally uncommon.

Biology

Very little is known of the biology of this species. The type locality, Beaver Creek, as described under *H. elissoma*, is a rather small stream with a predominantly sand bottom. The larvae collected here were removed from submerged logs and branches into which they bored out holes for larval retreats. The Little Bayou Pierre locality, on the other hand, is slightly different from most Louisiana streams in that the bottom consists of rocks and gravel with large riffle areas. The larvae at this locality were taken from the rocks in the riffle areas.

Little is known of the emergence of *H. decalda*. Some adults were taken at Little Bayou Pierre in March, and the type material was collected in September.

Hydropsyche carolina Banks
(Fig. 33A and B)

Hydropsyche carolina Banks, 1938. Psyche. 45:77-78 (Type locality: "North Carolina").

Hydropsyche carolina: Ross, 1944. Ill. Nat. Hist. Surv. Bul., 23:294. Flint, 1966. Proc. U.S. Nat. Mus., 118:375.

Description

Head capsule length, 1.10 to 1.25 mm; width, 1.00 to 1.15 mm. Except for small, circular, yellow area around eyes, entire head black. Head with a broad, concave frontoclypeus set off by an extensive arcuate carina. Frontoclypeus with greatest width just anterior to eyes. From widest point to posterior angle, frontoclypeal margins straight. Anterior margin of frontoclypeus straight. Genae covered dorsally and laterally with short, stout, black bristle-like setae; frontoclypeus devoid of such setae. Labrum black, covered with similarly colored setae, and margined laterally with brush of long, yellow setae. Mandibles black and typical. Thoracic nota lighter in color than head; dark brown dorsally, golden laterally. Each nota edged in black laterally and covered with short, stout, golden spine-like setae. Leg segments similar in coloration to nota. Each coxa and femur with proximal and distal borders trimmed in black. Setation on legs not unlike that of other *Hydropsyche* species. Prosternum golden brown edged anteriorly and posteriorly in black. Poststernal plates rectangular, dark brown; mesosternal plates triangular; metasternum lacking plates. Abdomen beige covered with short, thin, black setae. Dorsum of each segment with scale hairs with greatest number on last several segments; segments I - II with the least. Dorsal sclerite of anal legs covered with black setae; ventrally anal legs covered with numerous, short, black setae.

Diagnosis

This small and distinctive species is easily recognized on the basis of the presence of a wide carina on the head. It is the only known *Hydropsyche* larva which has such a carina and, with the present keys available, would key to *Macronema*. However, it is unlikely that anyone familiar with *Macronema* would confuse the two genera. There are a number of striking differences between *H. carolina* and any of the *Macronema* species. First, the carina is much more offset in *Macronema*. Second, the carina in *H. carolina* is produced by the suture joining the genae and frontoclypeus, whereas the carina of *Macronema* is lateral to the frontoclypeus-genae suture. Third, *Macronema* spp. are typically pigmented a bright green with *H. carolina* having dark brown to black coloration. Last, *Macronema* spp. are at least two to three times larger than the last instar of *H. carolina*.

Material Examined

Georgia:

Lakemont, Ga., 30-VI-39. P. W. Fattig (1 male, 3 females; INHS collection).

North Carolina:

Cullasaja R., 11.9 mi. above jct. N.C. 28 and Bypass U.S. 441 and 23, Macon Co., N.C., 9-V-76. D. A. Etnier (many larvae); Cullasaja R., 6 mi. W. of Highlands, Macon Co., N.C., 19-VI-76. G. A. Schuster (4 larvae, 1 male mmt., 3 female mmts.); Cullasaja R., 6 mi. W. of Highlands, Macon Co., N.C., 19-VI-76. G. A. Schuster (41 males, 34 females); Oconaluftee R., at Cherokee, Swain Co., N.C., 27-VI-76. D. A. Etnier (1 larva).

Distribution

Hydropsyche carolina has been so rarely collected that little can be said regarding its distribution. The few collection records available indicate that it is restricted to areas in and about the mountains of North Carolina and Georgia.

Biology

This species is one of the most poorly known and least understood of all *Hydropsyche* species. Our largest collections came from the Cullasaja River near Highlands, North Carolina. This river is impounded in Highlands with the reservoir overflow making up most of the water volume downstream. Due to this, the water temperature is atypically warm for much of the year even though the elevation is rather high (approximately 1,200 meters at Highlands). Most of the larvae as well as the largest known collection of *H. carolina* adults were taken at an elevation of about 1,000 meters. The river here has moderate-to-fast current with a depth of 0.5 to 1.5 meters and a width of 20 meters. The shore vegetation is primarily *Rhododendron* with little aquatic vegetation being present. The bottom consists primarily of large, smooth boulders to which *H. carolina* larval retreats and pupal cases were attached. The larval retreat is not unlike that of other *Hydropsyche* species, but the pupal cases were strikingly flimsy. They were first thought to be *Dolophilodes* pupal cases until they were later examined in the laboratory. Collected sympatrically with *H. carolina* were the following Hydropsychids: *Diplectrona modesta* Banks; *Cheumatopsyche campyla* Ross, *Hydropsyche betteni* Ross, and *Symphitopsyche sparna* (Ross).

The few collections of *H. carolina* indicate the species emerges in May to June.

Cuanis Species Group

Hydropsyche cuanis Ross
(Fig. 34)

Hydropsyche cuanis Ross 1938a. Ill. Nat. Hist. Surv. Bul., 21:147-148 (Type locality: Wilmington,Ill., 17-V-37, on Kankakee River. Ross and Burks).

Hydropsyche cuanis: Ross, 1944. Ill. Nat. Hist. Surv. Bul., 23:6, 87, 91, 93, 100-109, 294; Leonard and Leonard, 1949. Occ. Pap. Mus. Zoo., Mich., 522:9; Edwards, 1966. J. Ten. Acad. Sci., 41:120; Longridge and Hilsenhoff, 1973. Wisc. Acad. Sci., Art and Letters, 522:176.

Description

Head capsule length, 1.0 to 1.55 mm; head capsule width, 1.20 to 1.35 mm. The following description was given by Ross (1944:100); "Head and thoracic sclerites bright brownish yellow, the head with an irregular, fine, reddish brown pattern, the promotum with fine, reddish brown speckling; legs yellow. Frons almost flat, the apical margin straight. Dorsum of abdomen, especially on the seventh and eighth segments, with conspicuous flattened setae interspersed among the simple appressed ones." In addition to the above: Frontoclypeus covered with numerous, short, clear spine-like setae except for large, shiny area anterior to pair of large, inconspicuous spots. Dorsolateral aspects of genae and pronota with numerous such setae; mesonotum and metanotum with smaller and fewer spine-like setae. Frontoclypeus, genae and nota lacking long, thick, stiff, black setae. Abdomen with very few short, "simple appressed" hairs dorsally; more below pleural gills than above. Greatest concentration of such hairs on venter of them. Flattened hairs on dorsum more like club hairs of *Symphitopsyche* than anal hairs, very sparse on segments VII - VIII. Minute brown spines on dorsum of 4 abdominal segments. Dorsal sclerite of anal legs with long, brown setae ventrally without spine-like setae, with short setae.

Diagnosis

Hydropsyche cuanis may be distinguished from other species in the genus by the following combination of features. First, the sclerites of the larvae are reddish brown with two large, but not very distinct, spots on the frontoclypeus. The genae also possess many smaller and irregular spots especially on the top and sides. Second, the frontoclypeus, genae, and nota have numerous, small, brown spine-like setae and lack heavy, stiff, black setae. Third, the dorsum of the abdomen possesses numerous, minute spines, with few flattened setae and fewer short, thin appressed setae. The flattened setae are most abundant on segments VII - VIII, but even here they are not numerous. The venter of the abdomen and thorax also possesses more short, appressed hairs than does the dorsum of the abdomen. Last, the anal legs lack spine-like setae on the ventral surfaces.

Material Examined

Illinois:

Kankakee R., at Wilmington, Grundy Co., Il., 27-V-35. Ross and Mohr (1 male mmt.; INHS collection); Kankakee R., at Wilmington, Grundy Co., Il., 10-IV-35. Ross and Mohr (13 larvae; INHS collection).

Distribution

Ross (1944) indicates that the range is restricted to Illinois, Indiana, and Michigan, but more recent collection records extend the range northwest to Wisconsin (Longridge and Hilsenhoff, 1973) and south to Tennessee (Edwards, 1966).

Biology

Ross (1944:100) gave the following notes on the biology of *H. cuanis*: "Most of our Illinois records of this species are from various points along the Kankakee River; in addition we have taken it from two other points in the extreme northeastern corner of the state. The larvae are extremely abundant in swift rapids of the Kankakee River at Wilmington, and here we have taken large flights of the adults. In this locality the spring emergence during May is very heavy. Adults continue to emerge later in the year until August but never in the large numbers that we have taken in May."

Scalaris Species Group

Hydropsyche orris Ross
(Fig. 35A and B)

Hydropsyche cornuta Ross, 1938a. Ill. Nat. Hist. Surv. Bul., 21:168, preoccupied by Martynov, 1909 (Type locality: Hamilton, Il., August 30, 1931. Ross and Mohr).

Hydropsyche orris: Ross, 1938d. Wash. Ent. Soc. Proc., 40:121, new name; Ross, 1941. Tr. Amer. Ent. Soc., 67:86; Denning, 1943. Ent. Amer., 23:110, 111, 118; Ross, 1944. Ill. Nat. Hist. Surv. Bul., 23:9, 13, 88, 93, 95, 106-

107, 294; Leonard and Leonard, 1949. Occ. Pap. Mus. Zoo., Mich., 522:10; Etnier, 1965. Ent. News, 76:146; Unzicker et al., 1970. J. Ga. Ent. Soc., 5:171; Edwards, 1966. J. Tenn. Acad. Sci., 41:120; Edwards, 1973. Tex. J. Sci., 24:504; Longridge and Hilsenhoff, 1973. Wisc. Acad. Sci., Arts and Letters, 61:176; Resh, 1975. Trans. Ky. Acad. Sci., 36:12.

Description

Head capsule length, 1.35 to 1.50 mm; head capsule width, 1.30 to 1.40 mm. Anterolateral margin of frontoclypeus with large conspicuous denticles. Color pattern of head with clear, yellowish, V-shaped mark in middle of frontoclypeus. Lateral areas of this mark contiguous with clear area around eye. Anterior to V-shaped mark frontoclypeus with diamond-shaped black area. Coloration posterior to clear marking golden brown not as dark as anterior section of frontoclypeus. Head without conspicuous black bristle-like setae, but covered with small, slender, clear inconspicuous spine-like setae. Head in lateral view broadly rounded ventrally; dorsally flattened except for raised teeth on frontoclypeus. Laterally, large areas lacking dark coloration posterior and ventral to eye. Posterior one-fourth of head capsule lacking pigmentation. Labrum straw colored; lateral hair fringes also straw colored. Pronotum anterior edge almost lacking spine-like setae or hairs. Pronotum covered with very short spine-like setae that are same ground color, very indistinct. Pronotum laterally edged in black as is posterior margin. Pronotum and mesonotum without hairs; metanotum with few hairs, very short and slightly darker than sclerite. Thoracic sclerites and legs straw colored. Prosternum with black spots on anterolateral corners and black bar on the posterior border. Sclerites posterior to prosternum S-shaped, occasionally separated in center so that each sclerite is divided. Sternal plates on mesothorax wide and slender with lateral margins projecting anteriorad. Ventral gills typically arranged. Venter of anal legs covered with numerous slender, golden spine-like setae. Scale hairs very dense on dorsum of abdominal segments IV - VIII. No scale hairs below pleural gills. Abdominal segment III with scale hairs spaced farther apart, not as dense and decreasing greatly on segment II, and present only on lateral aspects of segment I. Minute spines on dorsum of all abdominal segments; greatest concentration on segments I - IV, becoming very small and inconspicuous posterior to segment IV.

Variation

Little variation of pattern exists either geographically or within a given population. Occasionally, the light, V-shaped mark may be broken and produce a pattern similar to that of *H. bidens*, but the coloration of the lateral and ventral aspect of the head rarely varies.

Diagnosis

This species is most closely related to *H. bidens*. At both the adult and larval level, these two species may at times be difficult to separate, as no consistent morphological characters could be found to separate the larvae. However, it was found that the color patterns of the head and ground coloration of thoracic sclerites and legs can be used to reliably separate the two species. Thoracic sclerites and legs of *H. orris* are straw colored to brownish yellow; whereas, in *H. bidens* these bear a golden brown to dark brown coloration. Differences in head capsule coloration are more pronounced. *Hydropsyche orris* bears a light, V-shaped mark (Fig. 35A) which is broken in the center in *H. bidens* to produce two distinct, large spots (Fig. 36A). From dorsal view, the entire posterior one-fourth of the head lacks pigmentation in *H. orris*. In contrast, there is dark pigmentation in *H. bidens* on either side of the suture line connecting the right and left genae. This gives the appearance of two large, oblong, light spots at the posterolateral corners of the head. In lateral view of *H. orris*, there are large areas where there is little pigmentation (Fig. 35B) especially around and posterior to the eye. *Hydropsyche bidens*, however, exhibits much dark pigmentation laterally (Fig. 36B). The area around the eye is light, but posterior to this there is only a thin, light line which separates the dark pigmentation of the dorsal and ventral aspects of the genae.

Material Examined

Arkansas:

North Sylamore Cr., off Gunner Rd., off Ar. 14, Stone Co., Ar., 20-V-74. G. A. Schuster (1 male).

Illinois:

Illinois R., at Starved Rock St. Pk., LaSalle Co., Il., 26-VIII-76. D. A. Etnier (3 mmts., many larvae); Kankakee R., at U.S. 45 and 52 jct. with Il. 115, Kankakee, Kankakee Co., Il., 8-IX-76. D. A. Etnier, G. A. Schuster, M. H. Hughes, N. M. Burkhead (many mmts. and larvae); Kankakee R., in Momence, Kankakee Co., Il., 8-IX-76. D. A. Etnier, G. A. Schuster, M. H. Hughes, N. M. Burkhead (1 male mmt., 12 larvae).

Louisiana:

Bogue Chitto, at La. 41, St. Tammany Par., La., 8-VI-74. J. A. Louton (many males); Atchafalia R., at Simmsport, Pointe Coupee Par., La., 14-VII-75. J. A. Louton (13 males); Baton Rouge, E. Baton Rouge Par., La., 10-VIII-73. J. A. Louton (4 males); Trout Cr., at White Sulphur Springs on La. 8, LaSalle Par., La., 25-VIII-73. J. A. Louton (many adults).

Minnesota:

Saganaga Falls, Lake Saganaga, Cook Co., Mn., 3-VIII-75. D. A. Etnier (2 male mmts., several larvae); Mississippi R., at Fort Snelling, Mn., 19-VII-75. D. A. Etnier (1 larva); Saganaga Falls, Lake Saganaga, Cook Co., Mn., 22-VII-75. D. A. Etnier (several mmts. and larvae).

Ohio:

Ohio R., Beckford Power Plant, 10 mi. upstream from Cincinnati, 21-VII-75. WAPORA (1 larva, several male, and female mmts.); Great Miami R., Miamitown, Hamilton Co., Oh., 13-VII-75. D. A. Etnier (6 male mmts., many larvae); Great Miami R., at Island Park, Dayton, Montgomery Co., Oh., 6-VII-76. G. A. Schuster (2 larvae); Great Maimi R., at Island Park, Dayton, Montgomery Co., Oh., 7-VIII-76. G. A. Schuster, F. Schuster (1 larva).

Tennessee:

Reelfoot lake, Tn 22, Obion Co., Tn., 18-V-74. G. A. Schuster (12 males, 13 females).

Distribution

Published distribution records include the following: Alabama, Arkansas, Georgia, Illinois, Indiana, Kentucky, Michigan, Minnesota, Ohio, Texas, and Wisconsin. This general scheme indicates that the distribution of *H. orris* lies within the Mississippi and Mobile Basins.

Biology

This species appears to be associated with big rivers. It, along with its sister species, *H. bidens*, seems to be able to cope with siltation better than most *Hydropsyche* species. Both are often collected in rivers with a high silt load and high concentration of suspended organic substances.

H. orris populations are often of staggering density, that is, individual larval retreats and pupal cases literally stack on top of one another. This is probably due to the high concentration of suspended organic matter in the rivers where they occur.

Pupal cases are constructed predominantly of secreted substances with sand grains attached to it. The pupal case is, therefore, rather flexible and differs from the general format of *Hydropsyche* pupal case construction. Because *H. orris* populations are so dense, it is not uncommon to find sloughed larval sclerites incorporated into pupal case construction. One case in particularly which was examined had a large number of larval sclerites embedded within the sand grain structure of the case. These consisted of several frontoclypea, nota, labra, and mandibles. Typical pupal case length is 8.0 mm; case width is 3.5 mm.

On several occasions *H. orris* pupal cases collected in the Saganaga River at Saganaga Falls, Minnesota, contained *Symphitopsyche recurvata* larva and pupa. This interesting association has never been noted before. It appears that, after *H. orris* emerges, *S. recurvata* utilizes the empty *H. orris* pupal cases in which to pupate. This allows *S. recurvata* to conserve energy that otherwise would have been spent in constructing its own case. Not all individuals of a *S. recurvata* population take advantage of this situation since they are more commonly collected in their own typical rock-structured cases.

From published and unpublished collection data, it appears that *H. orris* is univoltine, emerging from April to October.

Hydropsyche bidens Ross
(Fig. 36A and B)

Hydropsyche bidens Ross, 1938a. Ill. Nat. Hist. Surv., 21:142 (Type locality: Apple River Canyon St. Pk., 22-VIII-35. Delong and Ross).

Hydropsyche bidens: Denning, 1943. Ent. Amer., 23:109; Ross, 1944. Ill. Nat. Hist. Surv., 23:5, 91, 95, 197; Etnier, 1965. Ent. News, 76:146; Unzicker et al., 1970. J. Ga. Ent. Soc., 5:171; Longridge and Hilsenhoff, 1973. Wisc. Acad. Sci., Arts and Letters, 61:176.

Description

Head capsule length, 1.30 to 1.50 mm; width, 1.30 to 1.40 mm. Anterolateral margin of frontoclypeus with large, conspicuous teeth. Color pattern of head with two, large, clear, yellowish, oblique spots in the middle of the frontoclypeus. Lateral margins of these spots contiguous with yellow areas around eyes. Anterior section of frontoclypeus darker than posterior portion. Head without conspicuous black spines, but covered with small, slender, clear, inconspicuous spine-like setae. Head in lateral view broadly rounded; flattened dorsally except for raised teeth on the frontoclypeus. Laterally, area around eye yellow. Directly posterior to eye, a thin, clear line separates dark coloration of dorsal and ventral aspects of genae. Ventral aspects of genae with large areas of dark brown pigmentation. Dorsally, dark coloration along suture line connecting right and left genae. Thoracic sclerites and legs golden brown to dark brown. Labrum brown, lateral hair fringes similarly colored. Anterior edge of pronotum almost lacking bristle-like setae hairs. Pronotum covered with very short spine-like setae that are same as ground color. Pronotum laterally edged in black as is posterior margin. Pronotum and mesonotum without hairs; metanotum usually has short, thin hairs. Prosternum with black spots on anterolateral corners and black bar on posterior border. Prosternal plates S-shaped, occasionally separated in center so that each is divided. Sternal plates on mesothorax wide and slender with lateral margins projecting anteriad. Ventral gills typical; filaments abundant. Venter of anal legs covered with numerous, slender, golden spine-like setae. Scale hairs very dense on dorsum of abdominal segments IV - VIII; no scale hairs below pleural gills. Segments IV - VIII also with uniformly spaced, short, black setae. Abdominal segment III with scale hairs spaced further apart, these hairs decreasing greatly on segment II, and restricted to a few scale hairs only on lateral aspects of segment I. Abdominal segments I - VIII with exceedingly small spines which give a peppered appearance under lower magnifications. Minute spines interspersed between scale hairs and black setae which are most prevalent on anterior segments, especially on mesal areas of segment I.

Variation

The material examined showed no distinctive variation either geographically or within populations.

Diagnosis

This species is closely related to *H. orris*. They are often difficult to separate in both larval and adult stages. No consistent morphological characters could be found to separate the larvae of these two species. Color patterns of head and ground color of thoracic sclerites and legs can be used to reliably separate the two species. The thoracic sclerites and legs of *H. bidens* bear golden brown to dark brown coloration; whereas, on *H. orris* thoracic sclerites and legs are straw colored. Differences in head capsule coloration are more pronounced. The posterior one-fourth of the head of *H. orris* is devoid of coloration, where *H. bidens* has a medial posterior dark strip of pigmentation on each side of the suture connecting right and left genae. *Hydropsyche bidens* typically possesses two large, clear spots on the frontoclypeus (Fig. 36A). *Hydropsyche orris* has a large, V-shaped, light spot (Fig. 35A); rarely is it broken into two spots. In general, *H. bidens* has a darker coloration of all sclerites than *H. orris*.

Material Examined

Illinois:

Kankakee R., Momence, Kankakee Co., Il., 8-IX-76. D. A. Etnier, G. A. Schuster, M. H. Hughes, N. M. Burkhead (2 larvae); Kankakee R., Kankakee, Kankakee Co., Il., 1-IX-76. D. A. Etnier, G. A. Schuster, M. H. Hughes, N. M. Burkhead (9 larvae, 2 male adults); S. Fk. Rock R., at U.S. 51, Rockford, Winnebago Co., Il., 25-VIII-76. D. A. Etnier (1 adult male, 3 mmts.).

Minnesota

Crow R., Watertown, Carver Co., Mn., 17-VII-75. D. A. Etnier (several larvae); Crow R., Watertown, Carver Co., Mn., 27-VIII-75. D. A. Etnier (1 male mmt.); Minnesota R., at Montevideo, Chippewa Co., Mn., 8-VII-76. D. A. Etnier (several mmts. and larvae); Chippewa R., at Mn. 15, Montevideo, Chippewa Co., Mn., 8-VII-76. D. A. Etnier (many mmts. and larvae).

Distribution

Published distribution records include the following states: Arkansas, Illinois, Indiana, Iowa, Michigan, Minnesota, Wisconsin, Missouri, Ohio, and Texas.

Biology

This species, as in the case of its sister species, *H. orris*, is typically found in big rivers. These two species seem to be able to cope with heavy siltation and suspended materials. Often it is found in large numbers with larval retreats and pupal cases stacked one on the other. When found in association with *H. orris*, it is never in the numbers that one finds in *H. orris* populations. It is noteworthy that, when these two species are associated, *H. bidens* is often rare. This may indicate that *H. orris* outcompetes *H. bidens*.

Pupal cases are similar to those of *H. orris*; the case is covered with sand grains and is flexible.

Emergence data indicates that *H. bidens* is univoltine and emerges from April to September.

Hydropsyche aerata Ross
(Fig. 37)

Hydropsyche aerata Ross, 1938. Ill. Nat. Hist. Surv. Bul., 21:144-145 (Type locality: Aurora, Il., 17-VII-27. Frison and Glasgow).

Hydropsyche aerata: Ross, 1944. Ill. Nat. Hist. Surv. Bul., 23:101-102; Leonard and Leonard, 1949. Occ. Pap. Mus. Zoo., Mich., 522:10.

Description

Head capsule length, 1.45 to 1.60 mm; width, 1.25 to 1.40 mm. Head yellow except for dark pattern on dorsum. Color pattern dark brown and in rough outline of a cross with transverse arms wider than longitudinal bar. Clear spot at posterior angle of frontoclypeus where transverse and longitudinal bars meet. Head with scattered short, brown spines, mostly concentrated on dorsum of genae. Frontoclypeus with patch of numerous, minute, brown spine-like setae on midlateral margin. Labrum brown, covered with long, black setae; laterally margined with tuft of long, golden setae. Mandibles yellow; apex dark brown to black. Thoracic nota yellow to light brown, covered with short, black hairs. A few conspicuous, black bristle-like setae and spine-like setae on nota. Legs same color as nota and adorned with numerous, short, brown spine-like setae. Prosternum yellow with black posterior margin. Poststernal plates and mesosternal plates brown. Abdomen beige with numerous, short, black hairs. Scale hairs with greatest concentration on dorsum of last three segments. Few or no scale hairs on anterior segments, especially segments I - II. Interspersed on segments - IV are numerous, minute spines which give peppered appearance under lower magnifications. Dorsal sclerites of anal legs with short, black setae; some small, brown spine-like setae laterally. Venter of anal legs covered with numerous, short, brown spine-like setae.

Diagnosis

Hydropsyche aerata is disinguished from other *Hydropsyche* species by the following combination of characters. First, the color pattern of the head is unique to the species. Second there are no or very few scale hairs on the first several abdominal segments, the greatest number being on segments V - VIII. Last, there are numerous heavily sclerotized brown spine-like setae on the venter of the anal legs. Also see comments under diagnosis for *H. frisoni*.

Material Examined

Illinois:

Kankakee R., on U.S. 1 S. and 17 W. in Momence, Kankakee Co., Il., 8-IX-76. D. A. Etnier, M. H. Hughes, N. M. Burkhead, G. A. Schuster (3 mmts., 10 larvae); Kankakee R., at U.S. 45 and 52 in Kankakee, Kankakee Co., Il., 8-IX-76. M. H. Hughes, D. A. Etnier, N. M. Burkhead, G. A. Schuster (3 mmts., 2 larvae, 1 adult male).

Distribution

The known distribution of *H. aerata* includes the following states: Illinois, Indiana, and Michigan.

Biology

This species is not well known. Most of the published records of *H. aerata* are from the Kankakee River in Illinois. The two localities, listed above, are very similar physiographically and in close proximity to one another. The Kankakee River at these localities is a large midwestern river with very wide (100 meters) and shallow (0.3 to 0.6 meters) riffle areas. The bottom consists primarily of small-to-medium-sized rocks with a great deal of gravel. The color of the water is brownish with an apparent high suspended organic load. The numbers of net-spinning caddis larvae are very high. Other common Hydropsychids collected at these localities include: numerous *Cheumatopsyche* spp. larvae, *Potamyia flava*, *Macronema zebratum*, *Hydropsyche orris*, *H. bidens*, *H. incommoda*, *H. simulans*, and *H. phalerata*. All of these can unquestionably be classified as "big river" species since they are most commonly collected in such habitats.

Ross (1944) give May through August as the period of emergence.

Hydropsyche phalerata Hagen
(Fig. 38)

Hydropsyche phalerata Hagen, 1861. Syn. Neur. N. Am., p. 287 (Habitat: "St. Lawrence R., Canada: Washington (Osten Sacken); Pennsylvania (Zimmerman)").

Hydropsyche phalerata: Hagen, 1864. Verh. Zool. Bot. Ges., 14:823. Provancher, 1877. Nat. Can., 9:267; Provancher, 1878. Pet. Faune Ent. Can., 2:142; Provancher, 1878. Nat. Can., 10:147; Banks, 1892. Trans. Am. Ent. Soc., 19:367; Banks 1894. Ent. News, 5:180; Smith, 1900. Ins. N.J., p. 64; Banks, 1904. Proc. Ent. Soc. Wash., 6:214; Ulmer, 1905. Zoo. Insbiol., 1:68; Ulmer, 1907. Gen. Ins., 60:170; Ulmer, 1907. Cat. Coll. Selys 6, 1:66; Banks, 1907. Cat. Neur. Ins. U.S., p. 47; Sibley, 1926. Bul. Lloyd Libr. 27 Ent. Ser., 5:104; Betten, 1926. Mem. Cornell Agric. Exp. Sta., 101:524; Betten, 1934. Caddis Flies N.Y. St., p. 189; Banks, 1936. Psyche, 43:126, 129; Milne, 1936. Stud. N. Am. Trich., 3:73 (as syn. of *morosa*); Ross, 1938. Psyche, 45:18; Ross, 1941. Trans. Am. Ent. Soc., 67:90; Denning, 1943. Ent. Amer., 23:109, 111, 113-114 (Betten 1934 is syn. of *sparna*); Ross, 1944. Ill. Nat. Hist. Surv. Bul., 23:15, 86, 91, 93, 102, 294; Leonard and Leonard, 1949. Occ. Pap. Mus. Zoo., Mich., 522:10; Etnier, 1965. Ent. News, 76:146;

Longridge and Hilsenhoff, 1973. Wisc. Acad. Sci., Arts and Letters, 61:176; Resh, 1975. Trans. Ky. Acad. Sci., 36:12.

Description

Head capsule length, 1.35 to 1.50 mm; width, 1.10 to 1.30 mm. Background color of head yellow; frontoclypeus with golden brown image of an arrow pointing posteriorad. Genae with dark brown mottling bordering frontoclypeus. Wide transverse band of brown pigmentation with numerous, yellow spots posterior to eyes. Venter of head yellow. Posterior portion of frontoclypeus and dorsolateral surfaces of genae covered with short, golden spine-like setae. In addition to above setae, genae decorated dorsally and laterally by large, conspicuous, black setae that slightly increase in diameter distally. Apical margin of frontoclypeus produced into a low triangular point. Labrum golden brown; covered with thick, black setae and more slender, brown setae; laterally margined with brush of long yellow setae. Base of mandibles yellow; apically dark brown. Thoracic sclerites slightly darker than head. Pronotum and mesonotum covered by large, conspicuous black setae like those on head; metanotum with very few such setae. Nota also covered with short, clear, and inconspicuous spine-like setae. Coxal segments of legs brown; all other segments yellow. Setation of leg segments similar to that of other *Hydropsyche* species. Prosternum yellow, posterior margin with wide, black band; poststernal plates brown, elongated and pointed laterally. Mesosternal plates triangular. Abdomen brown. Dorsum covered with many scale hairs, short, black hairs inconspicuous except on anterior segments. Venter of abdomen lushly covered with short, black hairs but lacking scale hairs. Exceedingly tiny spines cover the dorsum of abdomen, seen clearly only under high magnification. Greatest concentration of these spines on first several segments. Dorsal sclerite of anal legs covered with black setae similar to those on head. Venter of anal legs with short, black hairs and numerous, short, clear, golden spine-like setae.

Variation

Larvae have been examined from five different states. The only variation found is darkness of the color pattern of the sclerites of the head and thorax. It has been observed that those larvae from Minnesota and Illinois have a greater contrast in color pattern. On the other hand, the southern material examined does not show this degree of contrast between the background and the pattern of the genae and frontoclypeus. No variation in the anterior margin of the frontoclypeus has been noted—it always protrudes as a low, triangular point.

Diagnosis

The most diagnostic character permitting the separation of *H. phalerata* from other *Hydropsyche* species is the anterior margin of the frontoclypeus (Fig. 38). No other species in the genus has an apical border of the frontoclypeus which forms a low, triangular point.

Material Examined

Illinois:

Kankakee R., in Momence, Kankakee Co., Il., on Il. 1 S. and 17 W., 8-IX-76. D. A. Etnier, M. Hughes, N. M. Burkhead, G. A. Schuster (several larvae); Kankakee R., at U.S. 45 and 52, in Kankakee, Kankakee Co., Il., 8-IX-76. D. A. Etnier, M. Hughes, N. M. Burkhead, G. A. Schuster (1 larva).

Kentucky:

Cumberland R., on Cumberland Falls Rd., 5 mi. W. of Ky. 264, Whitley Co., Ky., 29-VI-75. G. W. Wolfe, G. A. Schuster (several larvae).

Minnesota:

Mississippi R., at Fort Snelling, Mn., 19-VII-75. D. A. Etnier (several larvae, 1 male mmt.).

Tennessee:

Holston R., under I-40 bridge, Knox Co., Tn., 27-IV-75. D. A. Etnier (5 male mmts.); Holston R., under I-40 bridge, Knox Co., Tn., 8-VII-75. D. A. Etnier (1 male mmt.); Nolichucky R., at Solomon Island of unnamed Co. Rd., 12.6 mi. N. of Newport, Cocke and Greene Co. line, 26-X-75. D. A. Etnier (several larvae).

Virginia:

James R., at Va. 45, Goochland Co., Va., 13-VI-75. D. A. Etnier, W. C. Starnes (6 larvae); James R., at Peters Cr., on Va. 501, Bedford Co., Va., 30-VII-76. D. A. Etnier, G. A. Schuster (several larvae).

Distribution

Hydropsyche phalerata is widespread over eastern North America. Published records include the following states: Georgia, Indiana, Illinois, Kansas, Kentucky, Michigan, Minnesota, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, and Wisconsin.

Biology

Hydropsyche phalerata is typically collected in large, warm-water rivers. All the rivers in which we have collected *H. phalerata* can be classified as: (1) very wide with long, shallow riffle areas, (2) substrate consisting of small-to-medium-sized rocks with course gravel and often covered with silt, (3) high suspended organic load, and (4) warm water throughout the late spring and early fall months. *Hydropsyche* species often collected with *H. phalerata* include the following: *H. bidens*, *H. orris*, and *H. simulans*. Ross (1944) indicates that *H. phalerata* emerges from late April to September.

Hydropsyche dicantha Ross
(Fig. 39)

Hydropsyche dicantha Ross, 1938a. Ill. Nat. Hist. Surv. Bul., 21:146 (Type locality: Swansea, Ontario, 13-VIII-36. G. G. Parish).

Hydropsyche dicantha: Ross, 1944. Ill. Nat. Hist. Surv. Bul., 23:91, 93, 102, 294; Leonard and Leonard, 1949. Occ. Pap. Mus. Zool., Mich., 522:9; Morse and Blickle, 1953. Ent. News, 64:71; Etnier, 1965. Ent. News, 76:146; Longridge and Hilsenhoff, 1973. Wisc. Acad. Sci., Arts and Letters, 61:176; Resh, 1975. Trans. Ky. Acad. Sci., 36:12.

Description

Head capsule length, 1.15 to 1.30 mm; width, 1.00 to 1.10 mm. Head brown dorsally and ventrally; yellow laterally, around and behind the eyes. Frontoclypeus with numerous, stout, black setae, and four distinct yellow spots. One pair located medially on sclerite; other two spots located anterior and slightly lateral to these. Labrum golden with black setae; laterally margined with tuft of long, yellow setae. Mandibles golden boown, and edged in dark brown. Thoracic nota golden; laterally trimmed in black. Pronotum with numerous, short, black setae; mesonotum with less, and metanotum with still fewer. Prosternum yellow; anterior margin trimmed in black; black bar posteriorly. Poststernal plates and mesosternal plates brown. Legs yellow; first three segments trimmed in black. All segments amply adorned with small, brown spine-like setae. Abdomen beige with numerous, short, black hairs. Scale hairs moderately abundant; equally concentrated on all segments except first, which has much fewer. Dorsal sclerites of anal legs golden, covered with short, black setae. Venter of anal legs covered with short, black setae, but without large spine-like setae. Minute spines present on abdominal segments VIII - IX.

Variation

The only variation found in this larva is the shade of the ground color of the head. It is sometimes a darker bronze than the typical brown coloration. This variation has been found to be intra-populational.

Diagnosis

This species most resembles *H. demora* and *H. valanis* to which it is most closely related. All three species possess two pairs of distinct, round, yellow spots on the anterolateral margins of the frontoclypeus. *Hydropsyche valanis* with spine-like setae on the venter of the anal legs is easily separated from the other two species. *Hydropsyche dicantha* can be differentiated from *H. demora* in a number of ways. First, and probably the most important diagnostic feature of *H. demora*, is the restriction of scale hairs to the posterior three segments. Even on these segments, however, the scale hairs are very sparse and often difficult to locate without a compound microscope. *Hydropsyche dicantha*, on the other hand, has abundant scale hairs on all segments. Second, *H. dicantha* has numerous, distinct, short, black bristle-like setae scattered over the entire body of the frontoclypeus. *Hydropsyche demora*, on the other hand, possesses very short, clear spine-like setae on the posterior half of the frontoclypeus, and anterior half lacks setae.

Material Examined

Kentucky:

Horselick Cr., off Ky. 89 on unnumbered Co. Rd., Rockcastle Co., Ky., 12-V-76. G. A. Schuster (1 male mmt.); Silver Cr., on Ky. 876, 5 mi. W. of Richmond, Madison Co., Ky., 7-VII-76. C. and G. A. Schuster (several mmt., many larvae); Silver Cr., on Ky. 876, 5 mi. W. of Richmond, Madison Co., Ky., 13-VI-76. G. A. Schuster (several larvae).

Minnesota:

Baptism R., Finland, Lake Co., Mn., 9-VII-76. D. A. Etnier, M. A. Etnier, S. A. Etnier (1 male mmt., 2 larvae).

Ohio:

Stillwater R., Deweese Pk., Dayton, Montgomery Co., Oh., 6-VII-76. G. A. Schuster (3 larvae).

Distribution

Hydropsyche dicantha appears to have a northerly distribution, restricted to the eastern U.S. Published state and province records include: Kentucky, Michigan, Minnesota, New Hampshire, New York, Ontario, Washington, D. C., and Wisconsin.

Biology

Little is known of the biology of *H. dicantha*; however, some insight may be obtained by the extremely variable habitats in which it has been found. The four localities listed above represent an extremely wide range of environmental conditions. Horselick Creek, for example, has a substrate consisting primarily of sand and mud with few small rocks in the riffle area, while Silver Creek consists chiefly of algae-covered bedrock and few small, loose rocks. Both, however, are rather small, warm-water streams, 6 to 12 meters wide, and extremely shallow in the riffle areas (0.2 to 0.5 meters deep). The Stillwater River in Dayton, Ohio, can be classified as a large river with heavy siltation and a substrate consisting of small-to-large rocks. On the other hand, the Baptism River locality represents a medium-sized trout stream with fairly cold water throughout the year.

From the above information one can draw the conclusion that *H. dicantha* does not have rigid environmental requirements. It also follows that *H. dicantha* should be much more common than it apparently is. It is indeed widespread, but is by no means common throughout its range. This would indicate that other factors prevent this species from becoming more common. Two of these may be predation and interspecific competition. However, until this species is better understood, these remain only plausible conjectures.

Published collection records indicate that this species emerges from late June through September.

Hydropsyche demora Ross
(Fig. 40)

Hydropsyche demora Ross, 1941a. Trans. Amer. Ent. Soc., 67:86-87 (Type locality: Demorest, Ga., 1-VII-39. P. W. Fattig).

Hydropsyche demora: Ross, 1944. Ill. Nat. Hist. Surv. Bul., 23:294.

Description

Head capsule length, 1.40 to 1.60 mm; head capsule width, 1.25 to 1.40 mm. Frontoclypeus reddish brown with four distinct spots on anterior half of sclerite; one pair mesally located with second pair anterolateral to these. Posterior half of frontoclypeus with numerous, small, yellow pits containing short, clear spine-like setae; often many of these missing, leaving empty pits. Also, on posterior half of sclerite are 9-10 large, yellow, muscle scars. Genae brown bordering frontoclypeus; large, brown area behind eyes, and large, yellow areas lateral to gular suture. Brown areas inundated with numerous, yellow pits with short, clear spine-like setae. Genae with scattered, long, black setae dorsolaterally. Numerous, large, yellow muscle scars on dorsal mesal border of genae; from middle of frontoclypeus posterior. Yellow muscle scars on large, brown areas behind eye in two to three concentric semicircular rows. Lateral aspects of head around and behind eyes yellow. Venter of head brown, especially on stridulatory surfaces; with numerous, yellow, oblong muscle scars, particularly posteriorly. Labrum golden, clear laterally with short, dense, yellow setae, more abundant, long, brown setae, and laterally margined with tuft of long, yellow setae. Thoracic nota golden, pronotum slightly darker. Numerous, short, clear spine-like setae on pronotum; mesonotum with fewer; metanotum with none. Scattered, long, stiff, black setae on pronotum; mesonotum with several such setae; metanotum with none. Mesonotum and metanotum with short, thin, black hairs; pronotum with few or none. Pronotum with numerous, yellow muscle scars laterally; fewer near posterdorsal margin. Prosternum yellow; black posteriorly. Poststernal plates and mesosternal plates brown. Legs same color as nota, and abundantly adorned with short, brown spine-like setae. Abdomen brown with short, black hairs dorsally and ventrally. Scale hairs, restricted to last three segments, inconspicuous and very sparse. Dorsum of segments I - VII with numerous, minute, brown spines; becoming smaller posteriorly. Dorsal sclerite of anal legs yellow, covered with black setae. Venter of anal legs with numerous, short, brown hairs.

Variation

The small amount of variation observed in this species is restricted to the shade of the color pattern on the top of the head. In some larvae the pattern is dark reddish brown, while in other individuals, it is more golden.

Diagnosis

This species may be, at first glance, confused with *H. dicantha* to which it is closely related. Both species possess the four distinct spots on the frontoclypeus, but they differ in a number of other ways. First, and probably the most important diagnostic feature of *H. demora*, is the restriction of scale hairs to the posterior three segments. However, even on these three segments, the scale hairs are very sparse and often difficult to locate without a compound microscope. *H. dicantha*, on the other hand, has abundant scale hairs on all except the first two segments. Second, *H. demora* possesses very short, clear spine-like setae on the posterior half of the frontoclypeus. *Hydropsyche dicantha* has numerous, distinct, short, black setae scattered over the entire body of the frontoclypeus. These are absent in *H. demora*. Third, *H. demora* possesses numerous, yellow muscle scars on the frontoclypeus, dorsum, and venter of the genae; these are lacking in *H. dicantha*. *Hydropsyche valanis* also possesses the four yellow spots on the frontoclypeus and may look somewhat like *H. demora*. These two species can be separated by the presence of spine-like setae on the venter of the anal legs of *H. valanis* and their absence on *H. demora*.

Material Examined

Tennessee:

Conasauga R., at Tn. 74 bridge, Bradley Co., Tn., 4-V-75. C. A. Schuster, G. A. Schuster, D. A. Etnier, and Etnier family (numerous larvae); Little R., at Alcoa Water Treatment Plant, 0.5 mi. E. of Tn. 33, Blount Co., Tn., 22-VII-75. G. A. Schuster (2 male mmts., several larvae).

Distribution

Hydropsyche demora was previously known only from the type material. The known distribution of this species now includes Georgia and eastern Tennessee.

Biology

Very little is known of the biology of this species. The two localities from which larvae and/or metamorphotypes have been collected are quite different. That section of the Little River is approximately 4.8 kilometers upstream from the impoundment of Fort Loudon Reservoir. The river here is wide and divided by an island. The larvae and pupae were all collected on the south side of the island where there is a 5.0 meter-wide riffle approximately 0.5 meters deep with very strong current. The substrate consists of medium-size rocks and large broken pieces of concrete from an old bridge abutment. The water is brown and heavily laden with suspended materials, both organic and inorganic; this causes a great amount of siltation. Other *Hydropsyche* species collected here include *H. betteni*, *H. phalerata*, and *H. venularis*.

The Conasauga River locality is in direct contrast with the above collecting site. It is a beautiful stream with lush aquatic vegetation growing on a predominantly sand and gravel substrate, with small-to-medium-size rocks in the riffle area. The water is extremely clear with little observable siltation.

The only feature characteristic to both of these localities is that both directly drain mountainous terrain. It is quite possible that the Little River locality, before the impoundment of Fort Loudon Lake, was very similar to the Conasauga River and that *H. demora* has been able to survive despite environmental changes. It should also be mentioned that the two rivers are in completely different drainage basins. The Conasauga River is in the Mobile Basin, and the Little River is in the Tennessee River drainage.

Hydropsyche valanis Ross
(Fig. 41)

Hydropsyche valanis Ross, 1938. Ill. Nat. Hist. Surv. Bul., 21:144 (Type locality: Rockton, Il., 2-VII-31, along Rock River. Frison, Betten, and Ross).

Hydropsyche valanis: Ross, 1944. Ill. Nat. Hist. Surv. Bul., 23:6, 91, 95, 105, 294; Etnier, 1965. Ent. News, 76:146; Resh, 1975. Trans. Ky. Acad. Sci., 36:12.

Description

Head capsule length, 1.25 to 1.35 mm; head capsule width, 1.05 to 1.15 mm. Posterior one-fifth of top of head yellow; rest of head brown. Frontoclypeus with two pairs of distinct, round, yellow spots on the anterolateral portions of sclerite. Posterior half of frontoclypeus with a number of small, yellow spots. Genae yellow ventrally and around eye; margins bordering epicranial arms brown which posterior to eye widen and come to level of eye. Genae on sides and top with numerous, bristle-like, black setae. Frontoclypeus with similar setae scattered on posterior half of sclerite. Labrum dark brown with black setae; laterally margined with long, yellow setae. Mandibles yellow with black margins. Mesonotum and metanotum yellow; pronotum brown. Each notum with numerous, short, black, bristle-like setae. Prosternum yellow and bordered anteriorly and posteriorly in black. Prosternal and mesosternal plates brown and not heavily sclerotized. Legs yellow; anterior pair slightly darker. All legs abundantly adorned with spine-like setae and longer black setae. Abdomen tan colored; covered with numerous scale hairs not noticeably decreasing in size or number anteriorly. Minute spines on dorsum of all abdominal segments. Scale hairs on sides of abdominal segments below pleural gills. Venter of anal legs with numerous sclerotized spine-like setae; these setae heavily sclerotized at base; and long and slender apically. Setae on sclerites of last two abdominal segments similar to those on anal legs.

Diagnosis

This species most resembles *H. demora* and *H. dicantha*, to which it is most closely related. All three species possess two pairs of distinct, round, yellow spots on the anterior lateral margins of the frontoclypeus. *Hydropsyche valanis* is most easily separated from *H. demora* and *H. dicantha* on the basis of the spine-like setae on the venter of the anal legs. *Hydropsyche valanis* possesses these setae, but they are absent on the other two species. *Hydropsyche valanis* may be distinguished from other species with such setae on the anal legs by a combination of the following characters: (1) color pattern on the head, (2) scale hairs below the pleural gills on the abdomen, (3) bristle-like setae on the posterior half of the frontoclypeus, (4) spine-like setae on anal legs are long and rather slender while they are shorter and more heavily sclerotized in the other species.

Material Examined

Ohio:

Greater Miami R., at Miamitown, Hamilton Co., Oh., 13-VII-75. D. A. Etnier (7 larvae); Greater Miami R., at Island Park, Dayton, Montgomery Co., Oh., 6-VII-76. G. A. Schuster (2 male mmts., 1 larva); Greater Miami R., at Island Park, Dayton, Montgomery Co., Oh., 7-VIII-76. G. Schuster, F. Schuster (2 larvae).

Distribution

Published records include the following states: Illinois, Indiana, Iowa, Kentucky, Minnesota, and Wisconsin. Additional to this list are the above Ohio records.

Biology

The biology of this species is not well understood even though it is fairly widely distributed. Ross (1944) indicates that *H. valanis* may prefer larger rivers. The Greater Miami River, from which the known larvae and metamorphotypes were collected, is a large, warm-water river. The river is approximately 60 to 100 meters wide with very large riffle areas. The bottom consists of various-sized, limestone rocks over sand and coarse gravel. It has a high silt load with a great deal of organic suspended material.

Species collected with *H. valanis* include *H. orris*, *H. dicantha*, and *Symphitopsyche cheilonis*. *Symphitopsyche cheilonis* is the predominant caddisfly in the river and is present in astounding numbers. *Hydropsyche valanis* appears to be much rarer and is not commonly encountered.

Ross (1944) indicates that emergence of *H. valanis* takes place from May to late August.

Hydropsyche arinale Ross
(Fig. 42)

Hydropsyche arinale Ross, 1938a. Ill. Nat. Hist. Surv. Bul., 21:144 (Type locality: Oregon, Illinois, 18-VII-27. Frison and Glasgow).

Hydropsyche arinale: Ross, 1944. Ill. Nat. Hist. Surv. Bul., 23:6, 87, 91, 93, 104, 294; Unzicker et al., 1970. J. Ga. Ent. Soc., 5:171; Longridge and Hilsenhoff, 1973. Wisc. Acad. Sci., Arts and Letters, 61:176.

Description

Head capsule length, 1.35 to 1.50 mm; head capsule width, 1.20 to 1.35 mm. Head mostly brown with yellow areas around eyes and at posterolateral sections of genae. Frontoclypeus unicolored; no distinct light spots. Venter of head lighter than top, stridulatory surfaces slightly darker. Dorsolateral aspects of genae with short, brown, bristle-like setae; bristle-like setae present only on anterolateral corners of frontoclypeus. Posterior half of frontoclypeus with numerous, thin, clear, silky setae; present also on genae and all nota. Bristle-like setae lacking on nota. Labrum brown with numerous, long, brown setae; laterally fringed by long brush of yellow setae; mandibles brown. Nota and legs brown; legs covered with numerous, long, black setae and short, brown spine-like setae. Abdomen brown; sparsely covered by normal setae and scale hairs. Scale hairs small, 1/2 - 3/4 length of regular appressed hairs. Minute spines present on dorsum of all abdominal segments and venter of last two abdominal segments and anal legs. Large, heavily sclerotized spine-like setae lacking on venter of anal legs.

Diagnosis

The larvae of *H. arinale* can be distinguished by a combination of characters. These characters include: (1) the lack of a distinct color pattern on the head and the presence of a unicolored frontoclypeus, (2) the presence of many silky, clear, thin setae on the posterior half of the frontoclypeus, (3) the lack of bristle-like setae on all three thoracic sclerites, (4) the sparseness of scale hairs on the abdomen, and (5) the scale hairs are 1/2 - 3/4 the length of regular appressed hairs on the dorsum of the abdomen.

Material Examined

Illinois:

Indian Cr., Baker, Il., 12-V-38. Ross and Burks (1 male, 1 female mmt.);
Indian Cr., Serena, Il., 16-V-38. Ross and Burks (2 larvae).

Oklahoma:

Honey Cr., T.F.S.P. Ok., 29-IV-39. J. A. and H. H. Ross (2 male mmts., 6 larvae).

Distribution

Published records of *H. arinale* include the following states: Arkansas, Kansas, Missouri, Oklahoma, and Wisconsin. Ross (1944) describes the range of *H. arinale* as seeming "to follow rather closely the outer fringe of the oak-hickory forest."

Biology

Ross (1944) states: "It shows a preference for such streams as Indian Creek, which is relatively clear and provided with many riffles or rapids. Our only large collections of adults were taken in May, but emergence continues through August."

Hydropsyche scalaris Hagen
(Fig. 43)

Hydropsyche scalaris Hagen, 1861. Syn. Neur. N. Am., p. 286-287 ("Habitat: St. Lawrence R., Can. (Osten Sacken); Washington; N. Red R. (Kennicott)").

Hydropsyche scalaris: Hagen, 1864. Verh. Zool. Bot. Ges., 14:823; Packard, 1876. Guide Study Ins. Ed., 5:621; Banks, 1892. Trans. Am. Ent. Soc., 19:367; Banks, 1892. Ent. News, 5:180; Kellogg, 1895. Am. Natur., 29: 550; Smith, 1900. Ins. N.J., p. 64; Betten, 1901. Aquat. Ins. Adirondacks, p. 573; Banks, 1904. Proc. Ent. Soc. Wash., 6:214; Banks, 1904. Trans. Amer. Soc., 30:109; Banks, 1905. Trans. Amer. Ent. Soc., 32:14; Kellogg, 1905. Amer. Ins., fig. 334; Ulmer, 1905. Zool. Insbiol., 1:68; Ulmer, 1907. Gen. Ins., 60:171; Ulmer, 1907. Cat. Coll. Selys., 6, 1:65-66; Banks, 1907. Cat. Neur. Ins. U.S., p. 47; Banks, 1908. Proc. Ent. Soc. Wash., 9:155; Sleight, 1913. J. N.Y. Ent. Soc., 21:6; Dodds and Hisaw, 1925. Ecology, 6:386; Essig, 1926. Ins. W. N. Am., p. 177; Betten, 1926. Mem. Cornell Ag. Exp. Stat., 101:524; Muttkowski, 1929. Roosevelt Wildlife Ann., 2:192; Betten, 1934. Caddis Flies N.Y. St., p. 190-191; Neave, 1934. Int. Rev. Hydrobiol., 31:169; Milne, 1936. Stud. N. Am. Trich., 3:69, 72, 73; Banks, 1936. Psyche, 43:127, 129; Brimley, 1938. Ins. N. Car., p. 252; Balduf, 1939. Bion. Entomorph. Ins., 2; Denning, 1943. Ent. Am., 23:109, 112-113; Ross, 1944. Ill. Nat. Hist. Surv. Bul., 23:91, 95, 106, 294; Etnier, 1965. Ent. News, 76:146; Edwards, 1966. J. Tenn. Acad. Sci., 41:120; Nimmo, 1966. Can. Ent., 98:691; Corbet et al., 1966. Can. Ent., 98:1291; Blicke and Morse, 1966. Me. Ag. Exp. Stat. Tech. Bul., 24:6; Unzicker et al., 1970. J. Ga. Ent. Soc., 5:171; Longridge and Hilsenhoff, 1973. Wisc. Acad. Sci., Arts and Letters, 522:176.

Description

Head capsule length of northern larvae, 1.95 to 2.30 mm; head capsule width, 1.70 to 1.95 mm. Head capsule length of southern larvae, 1.50 to 1.70 mm; head capsule width, 1.30 to 1.45 mm. Head reddish yellow laterally, ventrally and posterodorsally. Frontoclypeus irregularly mottled brown against reddish yellow or yellow background. Genae with brown pigmentation bordering suture with frontoclypeus and each other. Posterior to eyes genae also with wide, mottled, brown mark joined to pigmentation bordering suture of frontoclypeus and genae. Ventral to this mark slightly ventrally bowed row of seven to nine circular, yellow muscle scars outlined in brown. Below this two additional rows of muscle scars not as distinctly marked. Posterior half of frontoclypeus with numerous, scattered, small, brown spine-like setae positioned in dark brown pockets. Dorsum of genae with similar setae, and scattered long, stiff, bristle-like, black setae. Some shorter, less stiff setae located behind and below eyes. Labrum brown with long, brown setae; laterally margined with tuft of long golden hairs. Mandibles brown, trimmed with dark brown to black. Thoracic nota brown; pronotum slightly darker than others, and with numerous, round, yellow muscle scars laterally. Long, black, stiff setae on pronotum; less in number on mesonotum; fewer still on metanotum. Numerous, short, golden spine-like setae on pronotum and mesonotum; few to none on metanotum. Conspicuous, short, thin, black hairs cover metanotum; fewer present on mesonotum; very few on pronotum. Legs brown; anterior legs slightly darker. All segments abundantly garnished with short, brown spine-like setae. Abdomen brown with numerous, short, fine hairs. With exception of first segment, scale hairs as abundant on dorsum of abdominal segments as short, fine hairs. Scale hairs on segment I very few in number. Dorsal sclerite of anal legs with fine, black setae; venter covered with numerous, short, heavy, brown spine-like setae.

Variation

The greatest variation observed immediately upon studying the larvae is the distinctive size differences between northern and southern larvae. At first, it was assumed that these were different species, but upon closer scrutiny, this was questioned. On the basis of adult male genitalia, the two could not be separated, and, other than differences in size, the larvae also seemed identical. It is still quite possible that these two forms are subspecies or possibly valid species. On the presumption that the larvae are identical except in size, they are treated here as one species.

The only other variation either within or between populations is the ground color pigmentation of the sclerites. This varies from yellow or straw colored to a reddish yellow or brown.

Diagnosis

The following combination of characters may be used to identify *H. scalaris* larvae. First, the presence of the minute, brown spines on the dorsum of all abdominal segments. Second, small, but distinct, spine-like setae are present on the posterior half of the frontoclypeus, the entire pronotum, and the mesonotum where they are fewer in numbers. Third, there are numerous, heavily sclerotized spine-like setae on the venter of the anal legs. Fourth, the color pattern of the head is distinctive, especially the several slightly curved rows of yellow muscle scars behind the eyes.

Material Examined

Minnesota:
Mouth of Sunrise R., Chisago Co., Mn., 20-VII-75. D. A. Etnier (1 male mmt., 4 larvae); Sunrise R., at Mn. 95, Chisago Co., Mn., 6-VII-76. D. A. Etnier (several mmts., several larvae).

Tennessee:
Bull Run Cr., on Tn. 62, just S. of Oak Ridge, Knox Co., Tn., 1-IV-76. D. A. Etnier, G. A. Schuster (several mmts., many larvae). Bull Run Cr., on Tn. 62, just S. of Oak Ridge, Knox Co., Tn., 18-IV-76. D. A. Etnier (3 male mmts.).

Virginia:
James R., at Peters Cr., on Va. 501, Bedford Co., Va., 30-VIII-76. D. A. Etnier, G. A. Schuster (1 male, 1 female mmt., and 5 larvae); New R., below U.S. 460 bridge, Giles Co., Va., 29-V-75. G. A. Schuster, D. A. Etnier (several larvae).

Wisconsin:
Red Cedar R., at Co. Rds. M and W, 22 Mile Ford, Dunn Co., Wi., 3-VII-76. D. A. Etnier (several mmts., several larvae).

Distribution

In the literature it is reported to be one of the most widely recorded species in the genus. Ross (1944:106) states: "The name *scalaris* is the one under which many species have been confused. The selection of a lectotype by Banks (1936b, p. 172) has given us a definite concept of this species for the first time." It is more than likely that the range indicated by earlier published records was somewhat exaggerated from its true range due to this confusion. Ross (1944) lists the following: Georgia, Indiana, Missouri, Oklahoma, Ontario, and Wisconsin. More recently published records include: Arkansas, Maine, Minnesota, Quebec, and Tennessee.

Biology

Even though this species was often reported in the literature, nothing was previously known of its larval biology. Regardless of the fact that it has been associated, still little is known of *H. scalaris*. The localities from which larvae and metamorphotypes were collected are rather different. They range from a small stream such as Bull Run Creek, with small rocks and gravel, to the New River, which is a large river with a great deal of bedrock. However, all the localities listed above have one thing in common; they can be termed warm-water, smallmouth bass-type streams.

Hydropsyche simulans Ross
(Fig. 2, 3, 4, 5, 6, 9, 10, 44A and B)

Hydropsyche simulans Ross, 1938. Ill. Nat. Hist. Surv. Bul., 21:139-141 (Type locality: Mount Carmel, Il., September 11, 1937, along Wabash River. H. H. Ross).

Hydropsyche simulans: Denning, 1943. Ent. Am., 23:109, 111, 117-118; Ross, 1944. Ill. Nat. Hist. Surv. Bul., 23:5, 13, 87, 91, 95, 104-105, 294; Etnier, 1965. Ent. News, 76:146; Edwards, 1966. J. Tenn. Acad. Sci., 41: 120-121; Unzicker et al., 1970. J. Ga. Ent. Soc., 5:172; Longridge and Hilsenhoff, 1973. Wisc. Acad. Sci., Arts and Letters, 522:176; Edwards, 1973. Tx. J. Sci., 24:504; Resh, 1975. Trans. Ky. Acad. Sci., 36:12.

Description

Head capsule length, 1.65 to 1.85 mm; width, 1.50 to 1.70 mm. Dorsum of head dark brown with pair of large, yellow spots on frontoclypeus. Laterally, genae with a large irregular yellow area, which posteriorly reaches dorsum of head. Venter mostly dark brown, especially on stridulatory surfaces and surrounding gular suture. Dorsolaterally genae with numerous, stout, black setae, and small, golden spine-like setae. Posterior to frontoclypeus, genae with numerous, oblong, yellow muscle scars on dark brown background. Labrum straw colored with long, black setae and laterally margined with tuft of long, yellow setae. Mandibles straw colored, dark brown apically. Pronotum brown, other nota straw colored. Each notum with scattered, stout, black setae; short, black hairs; and short, golden spine-like setae. Prosternum, poststernal plates, and mesothoracic plates yellow; prosternum with posterior black bar. Legs straw colored to yellowish brown and covered with numerous, golden spine-like setae. Abdomen light brown covered with short, black setae both dorsally and ventrally. Dorsum also with numerous scale hairs most numerous on posterior segments. Interspersed between scale hairs and other hairs are minute golden spines that are a peppered appearance under lower magnifications. Spines most numerous on segments I - IV; on more posterior segments, these spines extremely minute, less abundant, and distinctly visible only under oil emersion. Anal legs covered dorsally and ventrally with short, black hairs.

Variation

There is limited variation of color pattern within and between populations of *H. simulans*. The large, yellow areas on the side of the head may be inundated with brown pigment but never to the degree of *H. hageni* or *H. leonardi*. The only variation in the dorsal coloration is a difference in the size of the spots on the frontoclypeus. They may sometimes be larger and more conspicuous than in typical specimens (Fig. 3).

Diagnosis

This species is best separated from other *scalaris* group species by the color pattern of the head. The only species with which it may be confused are *H. hageni* or *H. leonardi*. These two species also possess a pair of spots on the frontoclypeus which are not as large or conspicuous as those of *H. simulans*. *Hydropsyche hageni* and *H. leonardi* also possess a much darker background color, being very dark to almost black. *Hydropsyche simulans* also possesses numerous, yellow muscle scars on the posteromesal sections of the genae.

Material Examined

Illinois:

Kankakee R., on U.S. 1 S. and 17 W. in Momence, Kankakee Co., Il., 8-IX-76. D. A. Etnier, M. H. Hughes, N. M. Burkhead, G. A. Schuster (several mmts. and larvae); Kankakee R., at U.S. 45 and 52 in Kankakee, Kankakee Co., Il., 8-IX-76. M. H. Hughes, D. A. Etnier, N. M. Burkhead, G. A. Schuster (3 mmts.).

Kentucky:

Cumberland R., on Cumberland Falls Rd., 5 mi. W. of Ky. 264, Whitley Co., Ky., 29-VI-75. G. W. Wolfe, G. A. Schuster (1 male mmt., several larvae).

Minnesota:

Chippewa R., at Mn. 15, Montevideo, Chippewa Co., Mn., 8-VII-76. D. A. Etnier (3 mmts., several larvae).

Tennessee:

French Broad R., one-fourth mi. below Johnson Bible College, Knox Co., Tn., 27-VI-75. D. A. Etnier, G. A. Schuster (several mmts. and many larvae); Holston R., under I-40 bridge, Knox Co., Tn., 8-VII-75. D. A. Etnier (1 male mmt., several larvae).

Texas:

Brazos R., Hwy. 4 bridge, Palo Pinto Co., Tx., 24-II-76. K. Stewart (many larvae and mmts.).

Distribution

Hydropsyche simulans is widespread over the central U.S. and also occurs in some of the more easterly states. State records of this species include the following: Illinois, Indiana, Iowa, Kansas, Kentucky, Minnesota, Missouri, Ohio, Oklahoma, Tennessee, Texas, and Wisconsin.

Biology

Larvae of *H. simulans* have only been collected from large rivers with long, wide riffle areas. The Cumberland, Holston, and French Broad localities listed above basically represent similar habitats. In each case, the rivers are very wide (30 to 60 meters), fairly muddy, and with large riffle areas. The substrate consists typically of medium-to-large-size rocks with abundant coarse gravel. *Hydropsyche simulans* seems to prefer the larger rocks and avoids the smaller ones which tend to be washed downstream by the current. The larval retreats and pupal cases are most often found on or near the bottom of the rocks with cracks and crevices used as anchoring points. Perhaps due to the large amount of organic material in the water, *H. simulans* is usually found in large numbers. Other *Hydropsyche* commonly collected with this species are *H. phalerata* and *H. orris*.

Ross (1944) indicates emergence of this species takes place from April to September.

Hydropsyche incommoda Hagen

Hydropsyche incommoda Hagen, 1861. Syn. Neur. N. Am., p. 290-291 (Type locality: "Georgia (Collection of Hagen)").

Hydropsyche incommoda: Hagen, 1864. Verh. Zool. Bot. Ges., 14:822; Banks, 1892. Trans. Amer. Ent. Soc., 19:367; Ulmer 1905. Z. Insbiol., 1:68; Ulmer, 1907a. Gen. Ins., 60:171; Ulmer, 1907b. Cat. Coll. Selys., 1:68; Banks, 1907. Cat. Neur. Ins. U.S., p. 47; Krafka, 1923. J. N.Y. Ent. Soc., 31:39, 45; Krafka, 1924. Ann. Ent. Soc. Amer., 17; Betten, 1934. Caddis Flies N.Y. St., p. 188 (not sensu Hagen); Betten, 1936. Mem. Cornell Ag. Exp. Stat., 101:524; Milne, 1936. Stud. N. Am. Trich., 3:73 (as syn. of *scalaris*); Banks, 1936. Psyche, 43:128, 129 (distinct species); Ross, 1938. Psyche, 45:17; Ross, 1944. Ill. Nat. Hist. Surv. Bul., 23:15, 91, 95, 106, 294; Unzicker et al., 1970. J. Ga. Ent. Soc., 5:171; Resh, 1975. Trans. Ky. Acad. Sci., 36:12.

Diagnosis

Hydropsyche incommoda larva cannot at this time be distinguished from *H. simulans* (see Fig. 3). Larvae and pupae have only been collected from the Kankakee River at Kankakee, Illinois. Perhaps with the collection of more material of this widespread species, it will be better understood, and characters can be found to separate it from *H. simulans*.

Material Examined

Illinois:

Kankakee R., at U.S. 45 and 52, Kankakee, Kankakee Co., Il., 8-IX-76. M. H. Hughes, D. A. Etnier, N. M. Burkhead, G. A. Schuster (1 male, 3 female mmts., 5 larvae).

Distribution

This species has been recorded from Arkansas, Florida, Georgia, Illinois, Kentucky, Louisiana, New York, and North Carolina.

Biology

Even though this species is widespread in eastern North America, little is known of its biology. The Kankakee is a larger river with wide riffle areas in which *H. incommoda* was collected. It was collected with *H. orris*, *H. phalerata*, *H. bidens*, and *H. aerata*. Ross (1944) indicates that *H. incommoda* emerges from April to late August.

Hydropsyche frisoni Ross

Hydropsyche frisoni Ross, 1938a. Ill. Nat. Hist. Surv. Bul., 21:142-143 (Type locality: Oakwood, Il., 24-IV-25, along Salt Fork River. T. H. Frison).

Hydropsyche frisoni: Ross, 1944. Ill. Nat. Hist. Surv. Bul., 23:10, 87, 91, 95, 105-106; Leonard and Leonard, 1949. Occ. Pap. Mus. Zool., Mich., 522:9; Etnier, 1973. J. Ga. Ent. Soc., 8:273.

Description

Head capsule length, 1.48 to 1.58 mm; head capsule width 1.25 to 1.30 mm. Head with pale yellow background color. Frontoclypeus with posterior one-fourth brown with about 6-8 oval yellow muscle scars. Central area of frontoclypeus with a transverse brown blotch extending across sclerite and with its anterior border extending along the transverse ridge laterally to the tentorial pits. The median anterior extension of this pigment occupies one-fifth the width of the sclerite and expands anteriad as a blunt, "Y-shaped" mark with the arms of the "Y" directed anteriolaterad (Fig. 51). Area between posterior brown triangle and median brown blotch typically pale yellow with a few yellow muscle scars narrowly ringed with brown, but brown pigment of these areas may be confluent. "Y-shaped" brown mark terminates about halfway between transverse ridge of frontoclypeus and anterior margin of sclerite. Anterior border of frontoclypeus with underlying pale brown pigment occasionally contiguous with the arms of the "Y-shaped" mark. Genae with a brown blotch posterior and dorsal to eyes that extends ventrad to level of eyes as two horizontal bands of yellow muscle scars ringed with brown. This blotch constricts before fusing or nearly fusing with brown blotch in posterior angle of frontoclyepus. Remainder of genae pale yellow except for brown pigment adjacent to sutures with frontoclypeus. Dorsal and lateral surface of genae covered wtih short, golden, bristle-like setae, these present but scattered and inconspicuous on posterior half of frontoclypeus. Longer brown setae along sutures between genae and frontoclypeus. Labrum yellow with brown setae, fringed laterally with longer yellow setae. Mandibles with yellow base and dark brown apices. Thoracic nota yellow. Pronotum with anterior border darkened; entire notum covered with scattered short golden spine-like setae and dark brown hairs. Mesonotum also covered with golden, spine-like setae and longer, darker hairs than those of pronotum; and with a "U-shaped" black mark posteriad. Metanotum lacking spine-like setae and with still longer, darker hairs; and with a median posterior black spot. Legs yellow with reddish brown claws, scattered long black setae, and covered with short, golden, spine-like setae. Abdomen with minute spines on first five segments. Scale hairs sparse on first two segments, gradually becoming slightly more dense on posterior segments, and absent below pleural gills. Bases of anal legs with thickened golden spine-like setae basally and ventrolaterally.

Diagnosis

The pale yellow color of the head capsule and thoracic nota are shared only with *H. scalaris*, *H. patera*, *H. phalerata*, and *H. aerata*. In both *scalaris* and *patera* the pronotum is consistently darker than the other thoracic nota, whereas in *frisoni* the nota are equally pale except for a slightly darker anterior border on the pronotum. Differs from *phalerata* in having the anterior border of the frontoclypeus straight. Most similar to *H. aerata* from which it differs in having less conspicuous spine-like setae on the ventral bases of the anal legs. In *aerata* these setae are of approximately the same size, shape, and color as those on the sclerites on the ventral surface of the ninth segment; in *frisoni* these setae are much smaller and less robust than those on the sclerites on the venter of the ninth segment. *H. frisoni* lacks the brown blotch surrounding the epicranial stem that is present in *aerata*, and has the posterior angle of the frontoclypeus brown rather than with a pale spot as in *aerata*. In *H. aerata* scale hairs on the abdomen are much more abundant on posterior than on anterior abdominal segments, whereas in *frisoni* there is a less noticeable increase in their abundance from anterior to posterior.

Variation

In addition to slight variation noted in the extent of brown pigment on the frontoclypeus (see Description), there is occasionally a small brown blotch in the anterolateral corner of the frontoclypeus.

Material Examined

Alabama:

Cahaba River at Co. Hwy. 27 bridge, Bibb Co., Ala., 15-IV-78. B. H. Bauer, D. A. Etnier (many larvae); Little Cahaba River at Bulldog Bend, along co. rd. 65, T24N, R 11E, S 25, Bibb Co., Ala., 15-IV-78. B. H. Bauer, D. A. Etnier (1 male from spider webb, 3 male mmts., many larvae).

Minnesota:

Mouth of Sunrise River at St. Croix River, Chisago Co., Minn., 6-VII-76. D. A. Etnier (4 larvae).

Distribution

Published distribution records are available for Illinois, Michigan, and Tennessee. The above records extend its range into Alabama and Minnesota.

Biology

Ross (1944) encountered this species in abundance only along the Middle Fork and Salt Fork rivers near Oakwood, Ill., where it emerged from April through August. Sunrise River is about 30 m wide at its mouth, and is a clear, shallow stream with gravel substrates. It appears to have a very diverse fauna. The Little Cahaba River, Bibb Co., Ala., is a pristine stream about 25 m wide with gravel and bedrock substrates in riffle areas. It contains a diverse assemblage of fishes including a health population of the threatened goldline darter (*Percina aurolineata* Suttkus and Ramsey). Cahaba River at the Bibb Co. Hwy 27 bridge has apparently recovered somewhat from industrial, domestic, and strip mining pollution, and also has a diverse fish fauna including the best remaining population of the undescribed Cahaba shiner, an endangered species. This suggests that *H. frisoni* is a small, warm water rivers that may be intolerant of habitat alteration.

Hydropsyche mississippiensis Flint
(Fig. 45)

Hydropsyche mississippiensis Flint, 1972. J. Ga. Ent. Soc., 7:80 (Type locality: Ms., Wayne Co., Waynesboro, 2-VIII-69. C. Bryson).

Description

Head capsule length, 1.50 to 1.60 mm; head capsule width, 1.40 to 1.50 mm. Frontoclypeus brown with two, large, central, yellow spots. Numerous bristle-like setae on posterior half of frontoclypeus. Posterodorsal sections of genae brown with numerous oval-shaped, small, yellow spots. Area around eye and ventral surface of genae yellow. Genae with numerous, bristle-like setae. Mandibles yellow, edged in dark brown. Labrum yellow with many black setae; laterally fringed with many, long yellow setae. Nota light brown; each with black, bristle-like setae; less numerous on metanotum. Prosternum yellow, posterior margin black. Prosternal and mesosternal plates yellow, not heavily sclerotized. All legs yellow with numerous, black setae and small, brown spine-like setae. Abdomen beige; scale hairs on dorsum least abundant on segment I, increasing posteriorly. Minute spines on dorsum of all abdominal segments and anal legs; anal legs lacking large, heavily sclerotized spine-like setae; covered with numerous, short, black hairs.

Diagnosis

The larvae of *H. mississippiensis* most nearly resembles those of *H. simulans* and *H. incommoda* to which it is closely related. The color pattern of the head is nearly identical in all three species, although *H. mississippiensis* can be readily separated from the other two on the basis of bristle-like setae (Fig. 13) present on the posterior half of the frontoclypeus. *Hydropsyche simulans* and *H. incommòda* lack such setae on the posterior section of the frontoclypeus.

Material Examined

Mississippi:

Leaf R., on I-59, just S. of Laurel, Jones Co., Ms., 25-V-76. G. A. Schuster, D. A. Etnier (1 male mmt., 2 larvae).

Distribution

This species was previously known only from the type material Flint (1972).

Biology

The Leaf River, from which the pupa and larvae were collected, is a medium-sized river with sand and bedrock bottom. The specimens were collected in the shallow riffle areas where sections of the bedrock were partially exposed.

Little is known of the emergence patterns of *H. mississippiensis*, but it appears that the emergence period ranges from May to August.

Hydropsyche venularis Banks
(Fig. 46)

Hydropsyche venularis Banks, 1914. Can. Ent., 46:252 (Type locality: Washington, D. C., June 22).

Hydropsyche venularis: Betten, 1926. Mem. Cornell Ag. Exp. Stat., 101:524; Betten, 1934. Caddis Flies N.Y. St., p. 191-192; Milne, 1936. Stud. N. Am. Trich., 3:73 (as syn. of *scalaris*); Ross, 1938. Psyche, 45:19 (description of lectotype); Ross, 1944. Ill. Nat. Hist. Surv. Bul., 23:294; Etnier, 1973. J. Ga. Ent. Soc., 8:273; Resh, 1975. Trans. Ky. Acad. Sci., 36:12.

Description

Head capsule length, 1.65 to 1.85 mm; head capsule width, 1.45 to 1.65 mm. Head bronze in color. Frontoclypeus with two pairs of yellow spots anterolaterally; anterior spots larger than posterior spots. Spots often fused to form two, large, anterolateral spots. Two, large, posterior, subrectangular spots on top of genae. Laterally behind eye, bronze with many small, yellow spots on four or five rows. Ventrally, head bronze with some yellow areas, especially along gular suture. Top and side of genae with anterolateral corners. Posterior half of frontoclypeus with minute spine-like setae located in yellow pockets. Labrum brown with numerous, brown setae, fringed laterally with numerous, yellow setae. Mandibles golden and edged in dark brown. Nota brown; pronotum and mesonotum with numerous, bristle-like setae; metanotum lacking such setae. Each notum bordered laterally with black. Legs similarly colored as nota and with numerous, small, spine-like setae and longer hair-like setae, not unlike other species. Prosternum yellow, bordered anteriorly and posteriorly in black; prosternal plates and mesosternal plates brown. Dorsum of abdomen with numerous, scale-like setae on all segments; minute spines on dorsum of abdominal segments I - VII. Minute spines present on venter of anal legs and venter of last two abdominal segments; large, heavily sclerotized spine-like setae on venter of anal legs lacking.

Variation

The major variation found in this species involves the spots on the frontoclypeus. There are typically two pairs of these spots; however, they often fuse to form two, large, diagonal, yellow spots anterolaterally on the sclerite.

Diagnosis

Hydropsyche venularis is readily identified on the basis of head capsule coloration. There are typically two, large subrectangular, yellow areas on the top and posterior portion of the head (Fig. 46). The frontoclypeus has two pairs of anterolateral spots which may fuse into two, large, lateral spots. Additional characters which may aid in identification are the presence of minute spines on the dorsum of the abdominal segments I - VII and small spine-like setae on the posterior half of the frontoclypeus (Fig. 15A and B) situated in yellow, round pockets.

Material Examined

North Carolina:

Tuckaseegee R., at U.S. 411, Dillsboro, Jackson Co., N.C., 27-VI-76. D. A. Etnier (2 male mmts.).

Tennessee:

Little R., 1.0 mi. S. of Townsend, Blount Co., Tn., 27-VIII-74. M. Hughes, B. Smith, G. A. Schuster (2 male mmts., 4 larvae); Conasauga R., at Tn. 74 bridge, Bradley Co., Tn., 4-V-75. C. and G. A. Schuster, Etnier Family (3 male mmts., many larvae); Little R., 4.0 mi. S. of jct. River Rd. and U.S. 411, Blount Co., Tn., 23-IV-75. C. and G. A. Schuster (1 male mmts.); Little R., 1.5 mi. S. of jct. of River Rd. and U.S. 411, Blount Co., Tn., 23-IV-75. C. and G. A. Schuster (10 male and 4 female mmts., many larvae); Little R., at U.S. 411, Blount Co., Tn., 23-IV-75. C. A. and G. A. Schuster (11 male mmts., several larvae); Little Tennessee R., at Coytee Springs, Loudon Co., Tn., 6-V-75. W. C. Starnes, G. A. Schuster (several male and female mmts.); Little R., 2.0 mi. S. of Townsend, Blount Co., Tn., on Tn. 73, 14-VII-76. M. Hughes, G. Schuster, W. Dickinson (several larvae); Little R., at Alcoa Water Treatment Plant, 0.5 mi. E. of Tn. 33, Blount Co., Tn., 22-VII-75. G. A. Schuster (1 male mmt., several larvae); Nolichucky R., at Solomon Island, 12.6 mi. N. of Newport, Greene and Cocke Co. line, 26-X-75. D. A. Etnier (4 larvae).

Virginia:

Little R., at Girls Camp, Giles Co., Va., 29-V-75. D. A. Etnier, G. A. Schuster (2 male mmts., 5 larvae); Stoney Cr., at jct. of Co. Rd. 80 and Va. 122, Bedford Co., Va., 30-VIII-76. D. A. Etnier, G. A. Schuster (several mmts. and larvae).

Distribution

Published distribution records include the following states: Kentucky, Missouri, New York, Tennessee, Virginia, Washington D. C., and Wisconsin. New state records given above are from North Carolina.

Biology

Hydropsyche venularis occurs in medium-size rivers characterized by large riffle areas. They are typically found on medium-sized rocks covered abundantly with aquatic vegetation. The pupae are often attached to the vegetation rather than the rock. In this situation the pupal case is completely cylindrical and enclosed on all sides by small pebbles. *Hydropsyche venularis* is often collected in association with *Symphitopsyche morosa*, *S. sparna*, and *S. bronta.*

This species has an emergence period from early April to late September.

Hydropsyche hoffmani Ross
(Fig. 16, 47)

Hydropsyche hoffmani Ross, 1962. Ent. News, 73:129-130 (Type locality: Radford Arsenal, Montgomery Co., Va., 4-10-VIII-56. R. L. Hoffman).

Description

Head capsule length, 1.85 to 2.0 mm; width, 1.70 to 1.80 mm. Head ventrolaterally yellow; some dark pigmentation may be present on stridulatory surfaces. Except for area around the gular suture posterodorsal part of head yellow; area around suture dark brown. Area of genae bordering suture of genae and frontoclypeus dark brown. Genae also with wide, transverse, brown band behind eye. Posterior half of frontoclypeus uniformly dark brown. Frontoclypeus with a pair of small but distinct yellow spots in the middle of the sclerite. Just posterior to apical margin of frontoclypeus and anterior to the paired spots is large, transverse, subrectangular, yellow area. Apical margin broadly convexly rounded and trimmed in dark brown. Frontoclypeus with a distinctly raised semicircular ridge originating near the anterolateral corners and running just posterior to tentorial pits. Entire head shiny with very few hairs or spines on the dorsolateral aspects of the genae. Those present are very small, clear, and inconspicuous. Head with a naked appearance, except under higher magnification. Body of labrum golden covered with long, black setae; anterior margin black; laterally fringed with tuft of long, yellow hairs. Mandibles dark brown. Anterior ventral apotome with large, rounded, and distinct tubercle. Thoracic nota golden with very few spine-like setae and covered with thin, short, brown hairs. All legs brown with first three segments trimmed in black. Segments of legs abundantly covered with distinct, brown spine-like setae. Prosternum mostly yellow. Poststernal plates solidly sclerotized. Abdomen brown to yellowish green with numerous, short, black hairs. Dorsum of abdomen covered with scale hairs with greatest numbers on posterior segments, fewest on segments I - III. Interspersed between the black hairs and scale hairs on segments I - III of the abdomen are minute brown spines; none posterior to segment III. Dorsal sclerite of anal legs covered with black setae; ventral aspects of anal legs covered by numerous, heavy, dark brown spine-like setae.

Variation

The only variation discovered in the numerous larvae examined is that of head coloration. Some larvae are distinctly darker in pigmentation so that the large, yellow area at the anterior section of the frontoclypeus is quite small and inundated with dark brown pigment. The same may be true with the large, yellow areas on the lateral aspect of the genae.

Diagnosis

This unique and extremely interesting species may be separated from other *scalaris* group species in a number of ways. First, the color pattern of the head and nota is unique in Eastern North American *Hydropsyche*. Second, the almost complete lack of setae on the head and nota which give the larva a "clean shaven" appearance is unique to this species. Third, the frontoclypeus is convexly rounded anteriorly and has very distinct semicircular ridge running from the anterolateral corners to just posterior to the tentorial pits. Fourth, the mesal portion of the anterior ventral apotome is produced into a prominent and rounded tubercle.

Material Examined

Virginia:

Roanoke R., off U.S. 11 and 460, just outside of Salem, Roanoke Co., Va., 28-V-75. G. A. Schuster, D. A. Etnier (several larvae); Roanoke R., at wayside park on U.S. 11, about 10 mi. W. of Salem, Roanoke Co., Va., 5-VII-75. D. A. Etnier (several larvae); Roanoke R., at Va. 419 in Salem, Roanoke Co., Va., 10-VII-76. G. A. Schuster (very many larvae, many male and female mmts.).

Distribution

The above Roanoke River localities are less than 60 miles from the New River at Radford Arsenal, the type locality and only previous record of this species.

Biology

The Roanoke River, from which all larval and metamorphotype material of *H. hoffmani* was collected, is a medium-sized river. At the Va. Hwy. 419 locality, the river is about 6.0 to 10 meters wide and 0.3 to 1.0 meters deep. The current is slow to moderately fast, and the water quality appears good. The shore vegetation consists of shrubs and mixed deciduous trees which give good shelter. The bottom is variable, consisting of small rocks and gravel in the riffle areas and large rocks in the long, smooth runs of the river where the water is the deepest.

Two species of *Hydropsyche* were collected at this locality, and two from *Symphitopsyche*. The two *Symphitopsyche* species, *S. walkeri* and *S. bronta*, were restricted to shallow riffle areas of the river where they were found on medium-to-small-size rocks. The two *Hydropsyche* species, *H. hoffmani* and *H. leonardi*, were collected only in the deeper and faster runs of the river. None were taken in the shallow riffles with *S. bronta* and *S. walkeri*.

There seemed to be a definite preference for very large rocks (approximately 45 kilograms) with large, flat areas, a situation quite unusual for *Hydropsyche* larvae. Most species prefer rocks with many crevices and cracks in which to anchor and build larval retreats. It was found that *H. hoffmani* preferred the upper areas of these rocks and that most of the pupal cases were attached to the flat surfaces on top of the rocks. In contrast, *H. leonardi* was collected closer to the substrate. *Hydropsyche hoffmani* and *H. leonardi* larvae were never found in larval retreats close to one another. It was found that the most effective collecting technique for these two species was to slowly feel the surfaces of the rocks underwater for retreats and pupal cases since the strength of the current and the weight of the rocks prohibited removal of the rocks for examination.

Limited emergence data are available for this species. From the collection dates of the type material and the metamorphotypes collected, emergence appears to take place at least from late June to August. When this species is more thoroughly studied, it will be found that emergence takes place, undoubtedly, over a much longer period of time.

Hydropsyche leonardi Ross
(Fig. 48A and B)

Hydropsyche leonardi Ross, 1938a. Ill. Nat. Hist. Surv. Bul., 21:145-146 (Type locality: Lovells, Crawford Co., Mi., 2-V-36, along N. branch AuSable R., 2 mi. above town. J. W. Leonard).

Hydropsyche leonardi: Ross, 1944. Ill. Nat. Hist. Bul., 23:294; Leonard and Leonard, 1949. Occ. Pap. Mus. Zool., Mich., 522:9.

Description

Head capsule length, 1.80 to 1.95 mm; head capsule width, 1.50 to 1.65 mm. Head on top and bottom dark brown to black; lateral aspects of head with duck-shaped mark; large, yellow area around eye; narrow, yellow band behind eye expanding dorsally at back of head. Frontoclypeus with pair of pinhead-size, yellow spots posterior to tentorial pits; spots often indistinct. Dorsolateral aspects of genae with many, stout, bristle-like, black setae; frontoclypeus with many such setae over entire sclerite except for shiny central area around tentorial pits; setae on frontoclypeus as long as those on genae. Labrum black with numerous, black setae; fringed laterally with numerous, long, yellow setae. Mandibles dark brown to black. Nota dark brown; pronotum slightly darker than other nota. All three nota with short, black, bristle-like setae, most numerous on pronotum, decreasing on mesonotum, fewest on metanotum. Prosternum brown, edged anteriorly and posteriorly in black. Prosternal and mesosternal plates brown and fairly well sclerotized. Legs brown, anterior pair darker brown, almost black. Each leg adorned with numerous, longer black setae and shorter spine-like setae. Abdomen brown, with numerous scale hairs on dorsum of posterior abdominal segments; decreasing in number anteriorly. Minute spines on the dorsum of all abdominal segments; decreasing in number and size posteriorly. Minute spines on venter of last two abdominal segments and anal legs very small and inconspicuous. Venter of anal legs with many, black setae.

Variation

The variation observed in this species is restricted primarily to the pair of spots on the frontoclypeus. In some specimens these spots are distinct and easily viewed, while in other specimens the spots may be almost totally obscured.

Diagnosis

This species is most closely related to *H. hageni* and *H. hoffmani*. It may be confused with *H. hageni* since the color patterns of the head of these two species are similar. *Hydropsyche hageni* (Fig. 49A and B) and *H. leonardi* (Fig. 48A and B) may be separated on the basis of the following characters. First, *H. leonardi* possesses many black, bristle-like setae (Fig. 15A and B) everywhere on the frontoclypeus, excluding a central area around the tentorial pits. The setae on the frontoclypeus are as long and as conspicuous as those on the genae, while the frontoclypeus of *H. hageni* is not covered with as many bristle-like setae as *H. leonardi*. The setae present in *H. hageni* are much smaller and rather inconspicuous; because of this lack of setal covering, the entire sclerite has a shiny appearance. The genae also do not have as many setae as those found on *H. leonardi*. Second, the minute spines on the venter of the last two abdominal segments and especially the anal legs are much larger, more numerous, and conspicuous in *H. hageni* than in *H. leonardi*. Third, the head of *H. leonardi* from dorsal view is subrectangular and slightly narrower anteriorly. The head of *H. hageni*, on the other hand, is almost square in outline from dorsal view. Last, the head pattern of *H. leonardi* is much darker and the pair of spots centrally located on the frontoclypeus are often very small and indistinct. The ventral surfaces of the head are almost uniformly dark brown; whereas, the venter of *H. hageni* has large, yellow areas.

Material Examined

Virginia:

Roanoke R., at Va. 419, Salem, Roanoke Co., Va., 5-VII-75. D. A. Etnier (1 male mmt., 1 larva); Roanoke R., at Va. 419, Salem, Roanoke Co., Va., 10-VII-75. G. A. Schuster (7 mmts., 8 larvae).

Distribution

The only published records for this species are from Michigan; therefore, the above collections represent a substantial increase in the known range of *H. leonardi*. The U.S.N.M. also has collections of *H. leonardi* from the Shenandoah River near Woodstock, Virginia, which were collected by Dr. O. S. Flint, Jr.

Biology

Hydropsyche leonardi is a little known species that has rarely been collected since its description. The larvae and the metamorphotypes have been collected only from the Roanoke River in Salem, Virginia. The Roanoke River at this locality is approximately 6.0 to 10.0 meters wide and 0.3 to 1.0 meter deep. The current is moderate to fast and the bottom consists of small rocks and gravel in the riffle areas and large rocks in the long, smooth runs.

Symphitopsyche walker, *S. bronta*, *H. hoffmani*, and a *depravata* group species were collected in the same area as *H. leonardi*. The *depravata* group species, *S. walkeri* and *S. bronta* were collected in the shallow riffle areas on and under small rocks. *Hydropsyche hoffmani* and *H. leonardi* were collected in the deeper, long runs on very large rocks. Neither *H. hoffmani* nor *H. leonardi* were collected in the shallow riffle areas. On the large rocks, *H. hoffmani* was far more abundant than *H. leonardi* and was found mostly on top of the rocks, while *H. leonardi* -- both larvae and pupae -- were collected on the sides of these rocks.

The few available records indicate that this species emerges at least from May through July.

Hydropsyche hageni Banks
(Fig. 49A and B)

Hydropsyche hageni Banks, 1905. Trans. Amer. Ent. Soc., 32:14 (Type locality: "Falls Church, Va.").

Hydropscyhe hageni: Banks, 1907, Cat. Neur. Ins. U.S., p. 47; Ulmer, 1907. Gen. Ins., 60:171; Banks, 1908. Proc. Ent. Soc. Wash., 9:155; Banks, 1936. Psyche, 43:127-128, 129; Milne, 1936. Stud. N. Am. Trich., 3:73 (as syn. of *H. scalaris*); Ross, 1938c. Psyche, 45:17; Brimley, 1938. Ins. N. Carolina, p. 251; Denning, 1943. Ent. Am. 23:109, 111, 119-121; Ross, 1944. Ill. Nat. Hist. Surv. Bul., 23:87, 91, 93, 103, 294; Etnier, 1965. Ent. News, 76:146; Longridge and Hilsenhoff, 1973. Wisc. Acad. Sci., Arts and Letters, 61:176; Resh, 1975. Trans. Ky. Acad. Sci., 36:12.

Description

Head capsule length, 1.70 to 1.85 mm; head capsule width, 1.55 to 1.70 mm. Lateral aspect of head with wide, yellow band connecting yellow area around eye and yellow area at back of head. Stridulatory surfaces of genae dark brown with numerous, eliptical, yellow muscle scars; mesally venter of head with large, yellow areas. Dorsum of head rich brown with pair of small, yellow spots just mesal to tentorial pits; sometimes with additional larger pair of anterolateral spots. Dorsolateral aspects of head behind frontoclypeus with numerous, eliptical, yellow muscle scars. The very posterior part of dorsum of head lighter than rest of head, often approaching yellow. Dorsolateral aspects of genae with moderate number of stout, bristle-like setae and numerous very thin and short, yellow hairs. Frontoclypeus with bristle-like setae only at extreme anterolateral corners. Posterior half of frontoclypeus with some very short, clear spine-like setae directed anteriad. Due to lack of abundant setae covering, all of head rather shiny, especially frontoclypeus. Labrum dark brown with brown to black setae; laterally with fringe of yellow setae; mandibles dark brown. Nota brown; pronotum slightly darker. Each notum with moderate number of bristle-like, black setae; pronotum with many, small, round, yellow spots from which emerge thin, yellow setae like those of genae. Numerous, short, black setae cover mesonotum and metanotum; last two nota without numerous, small, yellow spots. Legs light brown to yellow with numerous spine-like setae and long, black setae. Abdomen brown; scale hairs abundant on posterior segments, decreasing anteriorly, few on segment I. Minute spines present on dorsum of all abdominal segments decreasing in size and number posteriorly. Numerous, black hairs on venter of anal legs; heavy sclerotized spine-like setae lacking. Minute spines present on venter of last two abdominal segments and anal legs; spines conspicuous at 100 X magnification.

Variation

The degree of variation in *H. hageni* seems to be restricted to the color pattern of the frontoclypeus. Typically, there are two, small, yellow spots mesal to the tentorial pits, but the degree of distinctness is variable; often they are indistinct. On occasion, a second larger pair of yellow spots may be present anterolateral to these spots.

Diagnosis

Hydropsyche hageni (Fig. 49A and B) is most closely related to *H. leonardi* (Fig. 48A and B), and the two larval forms exhibit similar coloration patterns. However, they can be separated by a number of characters. First, the lack of bristle-like setae on the surface of the frontoclypeus of *H. hageni*, except in the anterolateral corners, is evident; the frontoclypeus of *H. leonardi* is abundantly adorned with such setae. The genae of *H. hageni* also do not have as many bristle-like setae as are found on *H. leonardi*. For this reason, the head of *H. hageni*, especially the frontoclypeus, takes on a glossy appearance. Second, the minute spines on the venter of the last two abdominal segments and anal legs in *H. hageni* are very conspicuous and large under 100 X magnification. They may even be observed under the high magnification of a dissecting microscope. In *H. leonardi*, on the other hand, the spines are less abundant and conspicuous at even 100 X magnification. Third, the color of the sclerites of the head and thorax of *H. leonardi* approach black, while the same sclerites in *H. hageni* are a rich brown. Last, the venter of the head of *H. hageni* has large, central, yellow areas while the venter of the head of *H. leonardi* is more or less unicolored dark brown.

Material Examined

Kentucky:

Cumberland R., on Cumberland Falls Rd., 5.0 mi. W. of Ky. 264, Whitley Co., Ky., 25-VI-75. G. W. Wolfe, G. A. Schuster (1 male mmt., numerous larvae).

Tennessee:

Clinch R., at Frost Ford, approx. 3.0 mi. E. of Sneedville, Hancock Co., Tn., 9-IX-75. G. A. Schuster (several mmts., many larvae).

Distribution

Published state and provincial records include the following: Illinois, Kentucky, Manitoba, Maryland, Minnesota, North Carolina, Virginia, and Wisconsin. In addition to these is the Clinch River locality in Tennessee.

Biology

Ross (1944) reports collecting larvae and pupae in the rapids of the Kankakee and Rock Rivers of Illinois, both of which are fairly large rivers. This is consistent to the type of habitat in which we have collected larvae and pupae in the southeast. Both the Cumberland and Clinch Rivers where *H. hageni* was collected are large rivers with extensive rapids areas and some bedrock. The larvae and pupae were taken in the fastest water on both large rocks and bedrock.

Emergence of *H. hageni* seems to take place from May through September.

Hydropsyche patera Schuster and Etnier
(Fig. 50)

Hydropsyche patera Schuster and Etnier, 1978. Kans. Ent. Soc. 51:218-221 (Type locality: Harpeth R., Tn.).

Description

Head capsule length, 1.60 to 1.75 mm; head capsule width, 1.35 to 1.45 mm. Head yellow with dark color pattern on top of head; some dark pigmentation on stridulatory surfaces on bottom of head. Frontoclypeus with striking color pattern; anterior half with seven, large, yellow spots; three spots in transverse row just behind anterior margin; row of four spots behind and parallel to these; in second row, lateral spots may join mesal spots. Posterior half of frontoclypeus mottled yellow and brown. Genae with broken brown transverse band behind eyes. Anterior margin of frontoclypeus slightly convex. Genae with scattered, stout, bristle-like setae; many smaller yellow to brown spine-like setae on posterior half of frontoclypeus and dorsolateral aspects of genae. Labrum tan; numerous, slender, black setae on top of sclerite; brush of long, golden setae form lateral fringe. Mandibles yellow; margins and apical end dark brown. Nota straw colored; pronotum and mesonotum with scattered bristle-like setae; bristle-like setae absent on metanotum. Legs yellow; anterior legs slightly darker; segments of all legs amply adorned.

with long, black setae and short, yellow and brown spine-like setae. Prosternum yellow, posterior margin black; prosternal and mesosternal plates brown. Scale hairs sparse on abdominal segments I - IV; increasing in density from segments V - VIII. Minute spines present on dorsum of segments I - VIII; present on venter of segments VIII - IX and on anal legs. Venter of anal legs with large, golden spine-like setae similar to those on ventral patches of segments VIII - IX.

Diagnosis

This species may be recognized on the basis of the following combination of characters. First, the color pattern of the head is unique in Eastern North American *Hydropsyche*. This species exhibits the most striking color pattern of any known species in the *scalaris* group (Fig. 50). Second, large, golden spine-like setae are present on the venter of the anal legs. Third, the scale hairs are sprase (Fig. 11) on segments I - IV of the abdomen.

Material Examined

Tennessee:

Harpeth R., 1.3 mi. N of jct. U.S. 70 and Co. Rd. 7338, Cheatham Co., Tn., 2-V-75. D. A. Etnier, G. A. Schuster (12 male, 2 female mmts., very many larvae); Harpeth R., 1.3 mi. N of jct. U.S. 70 and Co. Rd. 7338, Cheatham Co., Tn., 10-IX-75. G. A. Schuster, D. A. Etnier, R. D. Suttkus, M. H. Hughes, G. W. Wolfe, W. C. Starnes (several male and female mmts., many larvae).

Distribution

This species is known only from the Harpeth River in Cheatham County, Tennessee.

Biology

This species has been collected only on two occasions, and, therefore, very little is known concerning its biology. The habitat in which it was collected is a medium warm-water river which serves as a basin for a great deal of agricultural runoff. The river in these stretches contains a moderate-to-heavy silt and suspended organic material load. The bottom consists of sand, coarse gravel, and large boulder areas. The boulders lie in the swiftest rapids and serve as the habitat for this species. The larvae and pupae were mostly collected by running the fingers across the surfaces of these rocks and feeling for the larval retreats and pupal cases. Many of the boulders have a lush growth of aquatic vegetation occurring as long strands. Most of the pupal cases were attached and well concealed in this vegetation. Only one other *Hydropsyche* species was collected at this locality, and it was found to be living in close proximity to *H. patera*. This species is *H. simulans*, which was not as abundant as *H. patera*.

Since mature pupae were collected in both May and September with instars in various stages of development, it is surmised that the emergence period for this species is from late April to late September.

Remarks

Edwards (1966) reported *H. placoda* from the Stones River in Davidson County, Tennessee. In correspondence with him, he made the following remarks concerning these specimens: "I did compare most of my material with types in Ross' collections at Urbana, Illinois, and both he and I did note that the forms I was referring to as *H. placoda* were not precise fits with his." Unfortunately, these specimens have been lost, and the determination cannot be substantiated. However, we feel certain that those specimens Edwards called *H. placoda* were in actuality *Hydropsyche patera*, since his collections were only a few miles from the above Harpeth River locality. To complicate matters further, Edwards' Stones Rivers locality is now impounded.

Hydropsyche placoda has not yet been associated, and because *Hydropsyche patera* is closely allied to it, it is suspected that its larvae is not too unlike that of *Hydropsyche patera*. Judging from published records, *H. placoda* is a very-large-river species. This may be part of the reason for it remaining unassociated since larger rivers are difficult to collect.

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GLOSSARY

Anal Papillae - Four elongate lobes arising from the anal opening, which may or may not be extruded in preserved specimens. They function both in respiration and ionic transport.

Appressed Hairs - Thin, hair-like, dark brown to black setae covering the membranous epithelium of the abdominal and thoracic segments.

Bristle-like Setae - Stout, dark brown to black setae occurring on the thoracic nota and sclerites of the head, especially the genae and frontoclypeus.

Carina - A keel-like structure produced in *Hydropsyche* by the suture of a depressed frontoclypeus and elevated genae.

Club Hairs - Setae on the dorsum and sometimes the lateral aspects of the abdominal segments of *Symphitopsyche*. These setae are elongate, slightly widening at the apex and only a bit wider than the appressed hairs.

Epicranial Arm - Or frontoclypeal suture. That suture which connects the genae to the frontoclypeus.

Epicranial Stem - Or coronal suture. That suture at the posterodorsomedian area of the head which joins the genae or parietals.

Epicranial Suture - The entire suture consisting of right and left epicranial arms and epicranial stem.

Foretrochantin - The sclerite at the base of the anterior leg which in *Hydropsyche*, *Symphitopsyche*, *Cheumatopsyche*, and occasionally in *Potamyia* is forked.

Forked Stridulator - *Sensu* Ross, 1944. See foretrochantin.

Frontoclypeus - In Trichoptera, a single sclerite composed of the frons and clypeus. In *Hydropsyche* and *Symphitopsyche*, this sclerite is subtriangular in outline and separates the genae dorsally.

Genae - Or parietals. These large sclerites constitute the greatest proportion of the head capsule laterally and ventrally, and are dorsally separated by the frontoclypeus.

Gular Suture - Or ventral ecdysial line. The suture which connects the genae ventrally.

Hairs - Long, thin, flexible setae.

Larval Retreat - Tube-like structure, expanded at the opening, in which the larva lives. It consists of silk woven into fishnet-like mesh, often with a variety of debris attached to the outside.

Maxillary Palp - A lobe of the maxillary stipes.

Metamorphotype (*mmt.*) - Or pharate adult. That life history stage to the order Trichoptera, which allows for absolute adult-larva association. It is at that time in the life cycle of the caddisfly, when the sloughed larval sclerites have been pushed to the rear of the pupal case, and pupal metamorphosis has progressed to just prior to emergence of the adult. At this time the adult genitalia has sufficiently sclerotized to allow species identification.

Minute Spines - Spines located on the dorsum of some or all abdominal segments of *Hydropsyche* species, usually decreasing in size posteriad. Such spines are also found on the venter of the last two abdominal segments and anal legs.

Muscle Scars - Round or elliptical spots visible on the genae and/or frontoclypeus which are produced by attachments of muscles in the head. They may be either lighter or darker than ground color of the sclerite.

Pharate Adult - See Metamorphotype.

Pleural Gills - Elongate, conical gills located on the lateral areas of segments III - VII. All known Eastern North American species of *Hydropsyche* and *Symphitopsyche* possess 1, 3, 3, 3, and 2 pleural gills, respectively from segments III - VII.

Poststernal Plates - Subtriangular plates immediately posterior to prosternum.

Prosternum - Strap-like sclerite present on the venter of the prothorax.

Pupal Case - The cylindrical structure usually composed of pebbles and/or sand grains attached to the substrate in which pupation takes place.

Scale Hairs - Wide, subtriangular and scale-like setae found on the dorsum and sometimes the lateral aspects of some or all abdominal segments of *Hydropsyche* species. These hairs are usually most abundant on the last two or three segments, decreasing in number and sometimes in size anteriad.

Setae - Hairs, bristles, heavily sclerotized spine-like projections, and spurs which arise from pits in the cuticle.

Spines - Extensions or processes of the cuticle.

Spine-like Setae - Setae, which are usually heavily sclerotized and pointed, giving the appearance of spines.

Stridulatory Surface - Ventral striated area of genae on which is rubbed a prominence of the front femur.

Submentum - Mentum, *sensu* Ross, 1944. The lobed sclerite just anterior to the Anterior Ventral Apotome.

Tentorial Pits - External depressions near the center of the frontoclypeus in *Hydropsyche* and *Symphitopsyche*, that internally give rise to the tentorial arms which act as sites for muscle attachments.

Ventral Apotome - Or gular sclerite, *sensu* Ross, 1944. This sclerite in *Hydropsyche* and *Symphitopsyche* is divided into two distinct sclerites; the Anterior Ventral Apotome and Posterior Ventral Apotome. The anterior ventral apotome (Submentum, *sensu* Ross, 1944) is the subtriangular sclerite just posterior to the submentum. The posterior ventral apotome or protogula is much reduced and located just posterior to posterior end of gular suture.

APPENDIX A

SPECIES ASSOCIATED FROM EACH GENUS AND SPECIES GROUP WITH A LISTING OF STATES FROM WHICH THE METAMORPHOTYPES AND/OR LARVAE WERE EXAMINED

Genus *Hydropsyche*

Depravata Species Group

Hydropsyche betteni Ross (R)	Ky., N.C., Tn., Va.
H. carolina Banks	N.C.
H. decalda Ross	Ga., La., Tx.
H. depravata Hagen	Tn., Ga.
H. potomacensis Flint	Va.
H. elissoma Ross	Ga.

(R) = Originally associated by H. H. Ross, 1944.

Scalaris Species Group

Hydropsyche aerata Ross (R)	Il.
H. bidens Ross	Mn., Il.,
H. demora Ross	Tn.
H. dicantha Ross	Ky., Mn., Oh.
H. hageni Banks	Ky., Tn., Va.
H. hoffmani Ross	Va.
H. incommoda Hagen	Il.
H. leonardi Ross	Va.
H. mississippiensis Flint	Ms.
H. orris Ross (R)	Mn., Oh.
H. phalerata Hagen (R)	Ky., Tn., Va.
H. scalaris Hagen	Mn., Tn., Va., Wi.
H. simulans Ross (R)	Il., Ky., Mn., Tn., Tx.
H. valanis Banks	Oh.
H. venularis Banks	N.C., Tn., Va.
H. patera Schuster and Etnier	Tn.

(R) = Originally associated by H. H. Ross, 1944.

Hydropsyche Species Only Associated by Ross (1944)

A. *Cuanis* Species Group

Hydropsyche cuanis Ross	Il.

B. *Scalaris* Species Group

Hydropsyche arinale Ross	Il.
H. frisoni Ross	Il.

Genus *Symphitopsyche*

Symphitopsyche alhedra (Ross)	N.C., Tn.
S. bifida (Banks) (R)	Mn., Wi.
S. bronta (Ross) (R)	N.C., Tn., Va.
S. cheilonis (Ross) (R)	Oh., Tn., Va.
S. macleodi (Flint)	Ga., Tn.
S. morosa (Hagen)	Mn., N.C., Tn., Va.
S. piatrix (Ross) **	Ar., Mo.
S. recurvata (Banks) (R)	Mn., Wi.
S. riola (Banks)	Mn.
S. slossonae (Banks) (R)	Mn., N.C., Tn., Va.
S. sparna (Ross)	Al., Ky., N.C., S.C., Tn., Wi.
S. ventura (Ross)	Tn.
S. walkeri (Betten & Mosely)	Mn., Va.
S. etnieri (Schuster & Talak)	Tn.

(R) = Originally associated by H. H. Ross, 1944.

** = Probable Association

APPENDIX B

UNASSOCIATED *HYDROPSYCHE* AND *SYMPHITOPSYCHE* SPECIES WITH LISTING OF ALL LITERATURE AND KNOWN DISTRIBUTION OF EASTERN NORTH AMERICA

HYDROPSYCHE ALVATA DENNING

Denning, 1949c. Brook. Ent. Soc., Bul., 44:40 (Type locality: Jackson, Ms., 24-30-IV-46. P. H. Harden).	Ms., Il.
Unzicker et al., 1970. J. Ga. Ent. Soc., 5:171.	Ak.

HYDROPSYCHE BIDENTATA DENNING

Denning, 1947d. Ent. News, 58:249 (Type locality: Columbia, S.C., 5-VIII-43. D. G. Denning).	S.C.

HYDROPSYCHE CATAWBA ROSS

Ross, 1939a. Proc. Ent. Soc. Wash., 41:67-68 (Type locality: Catawba R., Catawba, N.C., 23-IV-38. Ross and Burks).	N.C.
Brimley, 1942. Ins. N.C. Suppl., p. 15.	N.C.
Ross, 1944. Ill. Nat. Hist. Surv. Bul., 23:294.	N.C.

HYDROPSYCHE FATTIGI ROSS

Ross, 1941a. Am. Ent. Soc., 67:88-89 (Type locality: 6 mi. W. of Concord, Ga., 11-V-39. P. W. Fattig).	Ga.
Ross, 1944. Ill. Nat. Hist. Surv. Bul., 23:294.	Ga.

HYDROPSYCHE IMPULA DENNING

Denning, 1948b. Ann. Ent. Soc. Am., 41: 398 (Type locality: Sunderland, Ma., 17-VII-38. J. F. Hanson).	Ma.

HYDROPSYCHE GUTTATA PICTET

(North American References Only)

Hydropsyche separata Banks, Ross, and Spencer, 1952. Ent. Soc., B.C., Proc., 48:46 (as syn. of *guttata*).	B.C.
As *H. separata*:	
Banks, 1936. Psyche, 43:129-130.	N.Y. Sask.
Ross, 1941. Trans. Am. Ent. Soc., 67:85.	Can., Mt., Wa.
Denning, 1943. Ent. Am., 23:109, 111, 121-122.	Mn.
Ross, 1944. Ill. Nat. Hist. Surv. Bul., 23:294.	Transcont.
Etnier, 1965. Ent. News, 76:146.	Mn.
As *H. corbeti*:	
Nimmo, 1966. Can. Ent., 98:688-689, 691.	Quebec

HYDROPSYCHE OPTHALMICA FLINT

Flint, 1965. Proc. Ent. Soc. Wash., 67:169 (Type locality: W. V., along Cacapon R., about 2 mi. S. of Capon bridge, 13-V-63. Field and Flint).	W.V.
Tarter, 1976. Limn. W. Va., p. 130.	W.V.

HYDROPSYCHE PLACODA ROSS

Ross, 1941. Trans. Am. Ent. Soc., 67:87-88 (Type locality: Namakagon R., Spooner, Wi., 5, 6-VI-36. Frison and Ross).	Wi.
Denning, 1943. Ent. Am., 23:109, 111, 115.	Wi.
Ross, 1944. Ill. Nat. Hist. Surv. Bul., 23:91, 93, 103-104, 294.	N.Y., Il., Mn., Mt., S.D., Wi.
Etnier, 1965. Ent. News, 76:146.	Mn.
Edwards, 1966. J. Tenn. Acad. Sci., 41:120.	Tn.
Nimmo, 1966. Can. Ent., 98:691.	Quebec
Corbet et al. Can. Ent., 98:1288, 1291.	Quebec
Longridge and Hilsenhoff, 1973. Wisc. Acad. Sci., Arts and Letters, 61:176.	Wi.

HYDROPSYCHE ROTOSA ROSS

Ross, 1947a. Trans. Am. Ent. Soc., 73:139 (Type locality: Tusculum College, Greene Co., Tn., 8-VIII-46. Wright).	Tn.

SYMPHITOPSYCHE VEXA (ROSS)

Ross, 1938b. Ill. Nat. Hist. Surv. Bul., 21:148-149 (Type locality: Bloomer, Wi., 5-VI-36. Frison and Ross).	Wi.
Denning, 1943. Ent. Am., 23:110, 112, 124-125.	Mn.
Ross, 1944. Ill. Nat. Hist. Surv. Bul., 23:88, 96, 97, 294.	Mn., Wi.
Leonard and Leonard, 1949. Occ. Pap. Mus. Zool., Mich., 522:10.	Mi.

Morse and Blickle, 1953. Ent. News, 64:71.	N.H.
Etnier, 1965. Ent. News, 76:146.	Mn.
Blickle and Morse, 1966. Me. Ag. Exp. Sta. Tech. Bul., 24:6.	Me.
Nimmo, 1966. Can. Ent., 98:691.	Quebec
Corbet et al., 1966. Can. Ent., 98:1291.	Quebec
Longridge and Hilsenhoff, 1973. Wisc. Acad. Sci., Arts and Letters, 61:176.	Wi.